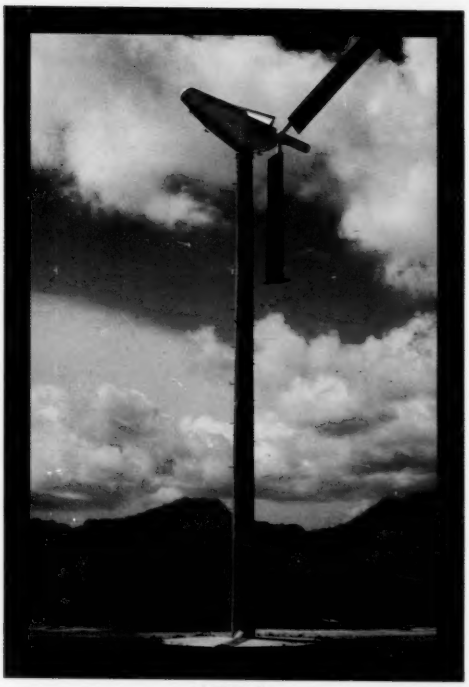
NAVY CIVIL ENGINEER

VOL. XX, No. 1

Solar



Wind

Geothermal

Development Of Natural Energy Resources

Career opportunities as an officer of the U. S. Navy Civil Engineer Corps

Construction and maintenance of the Navy's shore and support installations is just one of the responsibilities of the engineer managers of the Navy's Civil Engineer Corps. And qualification is not limited to the civil engineering discipline, as the Corps requires graduate engineers of mechanical, chemical, electrical, industrial and construction disciplines and architecture too! As a commissioned officer of the U.S. Navy the young engineer is offered greater opportunity to develop quickly a professional career with the added potentialities of an exciting overseas assignment, professional registration and graduate studies! The young officer may be assigned to construction contract administration, public works management or with a Naval Mobile Construction Battalion, the historic Seabees, plus many individual and unique positions.

Engineering students and counselors are invited to explore the multifaceted world of the Navy's Civil Engineer Corps by contacting their local Navy Recruiter for specific details. An informal visit with a Civil Engineer Corps officer to discuss the personal and professional benefits of a Navy career can be arranged by the same Navy Recruiter.

Call toll-free 800-841-8000 now if you desire instant information from the Naval Recruiting Command. If you're a good student, and want to be a better engineer, the chances are you'll do best by investigating the Civil Engineer Corps of the U.S. Navy.

ON THE COVER

The Navy's previous years of research in alternate energy sources is now being realized in the development and use of natural resources. The Civil Engineer Corps is responsible for energy development and its prudent use throughout the Navy's world.

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BILLYE NEWLEE
Associate Editor

MAINTENANCE & REPAIR, a constant challenge to the Naval Facilities Engineering Command, is outlined on a minor but important job at the U.S. Naval Academy. Please see page 23.

Please turn to Readers Survey page 31

NEXT ISSUE, another CEC/Seabee story of WWII will be related by Ted Murphy concerning an Advanced Base Sectional Dock (which served the fleet pictured below) — which was torpedoed!

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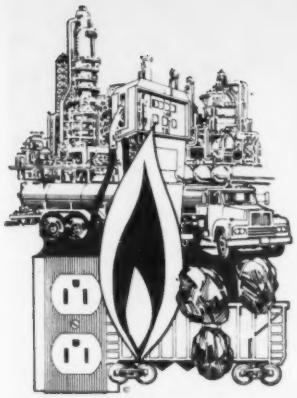
The quality of *The Navy Civil Engineer* is primarily dependent upon reader acceptance. Here's the opportunity to evaluate the periodical for editorial guidance.



Navy Energy Awareness

A Series By
JERRY THOMAS
Civil Engineering Laboratory

● Port Hueneme, Calif.

The Naval Facilities Engineering Command (NAVFAC) no stranger to energy conservation struggles, continues to support a productive energy research and development program that promises to have great effect on future energy savings.

In 1974 NAVFAC realized that threats of energy shortages were here to stay. It had the foresight to sponsor the development of the Navy Shore Facilities Energy R&D program which has become an integral cog in the Navy-wide efforts to conserve energy and develop alternate sources.

A review of the Navy's energy consumption during FY78 reveals that purchased electricity accounted for 55%; fuel oil, 29%; and natural gas, 14%; of total shore facilities consumption.

But by 1990, the total energy usage profile could change appreciably with the adaptation of the new techniques reflected by the R&D program. It is projected that the amount of purchased electricity could be reduced to 33% of the total consumption and fuel and natural gas decreased to 7% each.

The total shore facilities FY78 energy consumption equalled 31.3 million BOE (barrels of oil equivalent). This represents approximately 39% of Navywide usage for the same year. Attainable annual energy savings for FY90 are estimated at 53% for purchased energy and fossil fuels. These savings will be achieved by 28% in the area of conservation, and 25% through alternate energy sources.

These projections and percentages are cited in the Naval Shore Facilities Energy R&D Plan for FY80. The program is sponsored by NAVFAC and the Navy Energy and Natural Resources Research and Development Office. The Civil Engineering Laboratory (CEL), Port Hueneme, Calif., is the lead laboratory for the program.

The Energy R&D Plan, managed by the Energy Program Office at CEL, consists of three program areas:

Energy Conservation

- Minimize undesirable heat transfer into and out of buildings
- Improve efficiencies of HVAC and electrical systems
- Increase energy recovery in utility systems
- Provide monitoring and control systems to minimize energy demand while maintaining environments

Synthetic Fuels

Develop procedures, operating procedures and modifications to permit existing shore-based steam generators to burn synthetic and waste fuels.

Energy Self-Sufficiency

(Alternate Energy Sources)

- Solar heating and cooling of buildings
- Solar electric systems
- Wind power generators
- Coal Utilization
- Waste material energy recovery
- Energy Storage and advanced systems
- Geothermal power

The energy R&D program is structured to achieve maximum practical energy conservation and aid in substituting, where practical, alternate energy sources to replace petroleum and natural gas.

CEL provides the management and technical resources required to develop an energy technology base. This base, tailored to Navy needs, assimilates advances in the national energy program and transfers this advanced technology to NAVFAC and field activities. □

Geothermal

Solar

Wind

Light

Wind Power

The Navy recognized the potential of wind power as an economical alternate energy source in 1974 when the Civil Engineering Laboratory, Port Hueneme, implemented a monitoring and evaluation program to reduce consumption of nonrenewable energy within the naval shore establishment.

The oil embargo of 1973 created a new sense of energy development and wind turbines were back in the lineup. Subsequent interests reveal that wind energy conversion systems (WECS) have promise of providing a significant portion of the United States' electrical energy supply.

Through its wind energy program, the Navy ultimately will examine for suitability all types of WECS being developed by the Department of Energy and private industry. The goal is to produce maximum use of wind power if determined to be economical.

Approximately 180 Navy bases have average wind speeds greater than 10 mph and could be considered as possible locations for wind machines. It is estimated that if wind systems were installed Navywide, energy savings would equal 700,000 barrels of oil annually.

CEL is lead laboratory in the Navy wind program involving shore facilities. The objective is to provide the design, reliability, operating, maintenance, and cost information needed to develop Navy utilization of wind developed energy. The Energy Program Office at CEL reports to the Naval Facilities Engineering Command (NAVFAC) which is under the Navy Material Command (NAVMAT), Energy and Natural Resources R&D Office. NAVMAT is the action center for the Navy Energy Program.

To effectively apply wind power, engineers must first determine the feasibility of installation. Dharam Pal, principal investigator of the wind program at CEL, said that if application is favorable, appropriate designs and procedures must be available.

If the Navy decides on a small system (under 100 KW) it probably would purchase the hardware and install it. In the case of larger systems (above 100 KW) the Navy could enter into a joint agreement with a utility company, buying power from a commercial wind system to supply energy aboard Navy property.

Pal said it is doubtful that the Navy will ever purchase a significant quantity of large wind turbine systems but it may contract with private industry to develop such on federally-owned land. The Navy also is exploring the possibility of cooperative development with various government agencies for wind turbine systems of mutual benefit.

In its monitoring and evaluation program, CEL selects wind machines representative of certain classes that appear suitable for Navy application. The laboratory does not product-test but reviews generic categories to determine operating characteristics and idiosyncrasies. After the machine is purchased the laboratory inspects it for mechanical construction. It is then installed on a tower for a shakedown test lasting up to a year. During that time, engineers document the machine's behavior in terms of daily operation, maintenance requirements, and reliability specifications. Response to safety features also are carefully monitored.

Following the initial test period, the wind machine is installed at a carefully selected site for demonstrations lasting one to four years. These tests will develop detailed operational and maintenance data, reliability analyses and economic information. Information obtained from these demonstrations will be included in the periodic revision of a wind system application guide for Naval shore facilities.

After tests, the test units (wind turbine generator, tower, power conditioning equipment, etc.) may be turned over to the facility where the tests were conducted or moved to a new site for additional long-term testing under different wind conditions.

CEL already has installed five WECS units. This summer a 6 KW grid integrated wind turbine generator was mounted on a 60-foot tower at the Naval Support Activity, Treasure Island, San Francisco Bay. The largest windmill under test by the Navy has been installed at Kaneohe, Hawaii. It is a 20 KW wind turbine generator, a Grumman system featuring a three-phase synchronous inverter. The system's 25-foot diameter metal propeller is situated atop a 38-foot high cylindrical concrete tower. The center of the blade stands 41 feet above the ground. The generator attains a maximum output of 20 KW of direct current power when driven by 29 mph winds. The inverter changes the power into alternating current which is then transferred to a power grid for use on base.

THE NAVY'S LARGEST windmill is at Kaneohe, Hawaii

CEL also has installed generators in San Diego, San Nicolas Island off the Southern California coast, and at the laboratory. The Navy and the State of Hawaii will soon enter into a joint cooperative agreement to demonstrate and evaluate various capacity wind generators. □

Geothermal Energy

The Navy is well aware of the great potential of geothermal resources as an alternate energy source decreasing dependence upon purchased power.

Development of geothermal applications also would improve strategic postures of certain facilities and produce electric power that could be distributed to other naval installations.

The Navy's Geothermal Program, sponsored by the Navy Energy & Natural Resources R&D Office and the Naval Facilities Engineering Command (NAVFAC), is developing a technical, economic and institutional assessment of resources on Navy lands.

The major effort provides the basis for development of resources while concurrently assuring that the Navy's primary missions are not violated. The Naval Weapons Center (NWC) China Lake, is the lead laboratory in the program as managed by the Civil Engineering Laboratory, Port Hueneme.

The Navy is sitting on several encouraging geothermal sites. Current initiatives in the program are centered at China Lake; Fallon, Nev.; Adak, Alaska; and Oahu, Hawaii.

At Fallon, engineers are conducting geophysical tests at various ranges, evaluating the area for possible space heating applications and electrical power. Tests include soil sampling for mercury, heat flow holes and observation wells. At Adak, geothermal potential is being explored as a source for space heating and possibly electrical power. Preliminary data gathering and literature searches are underway at Oahu to determine its potential.

But the literal hot bed of activity is at the Coso Hot Springs *known geothermal resource area* (KGRA) at China Lake. It represents the Navy's largest potential source of geothermal energy. The center started basic exploration in 1967. A formal geothermal division was formed in 1977 under Dr. Carl F. Austin. Accordingly, ensuing compilations of efforts, accomplishments and evaluations have formed the nucleus of the most comprehensive documentation of geothermal technology and data.

The Coso field incorporated approximately 80,000 acres of high potential lands with about 50,000 acres belonging to the Navy. Dr. James Whelan, geologist in charge of geotechnical services, said estimates of the potential of the KGRA range from a high of 4,000 megawatts to a low of 600 megawatts. Translated, that represents sufficient power for a city of 500,000 people (low estimate) to four million inhabitants (high projection); or 1,000 people per megawatt.

One of the prime responsibilities of the NWC group is to guard against encroachment by other interests. It is developing sufficient resources data to protect both local missions and Navy-owned, or controlled, resources from encroachment pressures. NWC, which needs all of its present space to perform its assigned missions, seeks to control the geography and geology of the field (valleys, dry lakes, etc.). It is partners in an inter-service usage program of restricted air space.

The center, an installation with relatively high power requirements, is striving toward energy self sufficiency. Obviously, a successful geothermal program would mean a giant step toward such a realization. In fact, if the program reaches fruition, the center could produce enough

(continued next page)

DRILLING of the first Coso exploratory well is at the Naval Weapons Center, China Lake.

Geothermal Energy

(continued from preceding page)

"excess" energy to supply power to all Navy bases in Southern California.

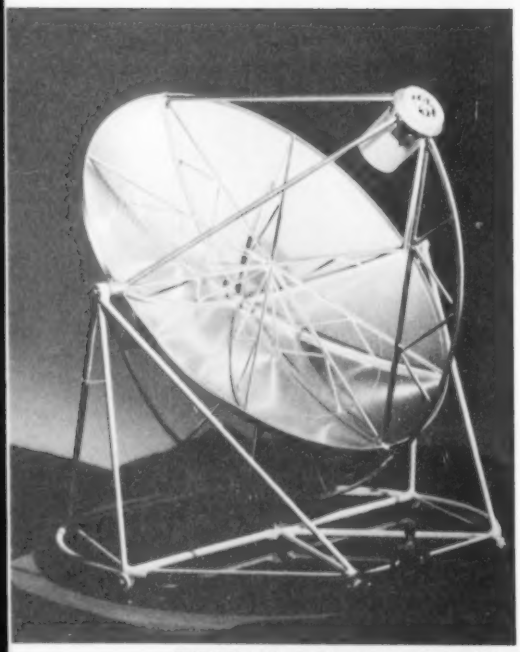
During the years, NWC has developed criteria which will ultimately enable the Bureau of Land Management (BLM) to lease other portions of the KGRA, under Navy lands, without interference to the center's mission. Dr. Whelan said this portfolio of "know how" makes geothermal exploration compatible with weapons testing. Contractors now must comply with strict Navy security and safety regulations. Typical requirements during development insist that power plants must have hardened control rooms and that well heads are protected with subsurface flow limiters and revetments to prevent blowouts if the well site were damaged during weapons testing. Such requirements should add only about 2% to the total cost of the project.

All this expertise (criteria, evaluations, data) is proving invaluable as NAVFAC currently reviews technical proposals from private contractors to explore and evaluate 3½ square miles of Navy fee-acquired lands in the Coso. NAVFAC is studying management qualifications and capabilities submitted by interested companies. Those ruled eligible will be permitted to submit proposal bids.

Under terms of the agreement, the selected contractor (if encouraging exploratory data is developed) will be obligated to build a power plant at his expense and sell the power (below commercial rates) to the Navy on a 30-year contract with an escalation clause. Any pending contract will stipulate that construction of a power plant would not entail any capital expense to the government, would not present an adverse impact on the NWC mission, and would result in net cost savings for the government. A contract is expected to be let next year and an on-site plant should be operational in five years.

In its drilling operations at the Adak naval complex, two observation holes have been drilled at 1,000 and 2,000 feet. Preliminary data indicate a good probability for geothermal resources to accommodate space heating and possibly electric generation. A successful discovery ultimately could completely eliminate Adak's dependence upon jet fuel other than for aircraft operations. Each year the Adak facilities use approximately nine million gallons of jet fuel for generating electricity and space heating. □

Solar Generated Power



THE SOLAR thermal power system will be tested at the Marine Corps Air Station, Yuma, Ariz. Model (above) indicates 30-foot concentrator where temperatures reach approximately 1500°F.

The Navy has established requirements for the development of a small modular solar thermal power system.

Generating electrical power from solar thermal energy is approaching reality. There are two general categories based on their sizes and characteristics. The first category is the heliostat field with a central tower receiver system for large electrical power stations (megawatt range). An example is the 10-megawatt pilot plant under construction near Barstow, Calif.

The other category is the small modular solar thermal power system (kilowatt range) with a distributed receiver and an individual heat engine to each solar concentrating collector. Because of the limit of Navy land and application, CEL is investigating the modular system in the 10-20 kilowatt range. A joint effort has been initiated by DOE with JPL which has the responsibility for development of the small systems.

The candidate system is a paraboloidal dish shape concentrating solar collector (approximately 30 feet in diameter) mated to a compact, efficient and reliable heat engine, either a cycle gas turbine or a cycle engine.

The first phase of the joint plan is to develop and demonstrate the technology of the modular solar thermal power system with a turbine engine by 1982.

The high-technology, high-risk cycle engine system will be developed and evaluated in another plan by DOE and JPL. CEL's technical staff will continue to evaluate and compare both systems performances and finally recommend the best system for Navy applications.

A committee of JPL and CEL representatives is in the process of selecting a demonstration site on a Navy base. The selection criteria for determining the site include solar insolation, wind conditions, sufficient land areas, and availability of qualified operators. Final ranking of candidate bases has been completed with Yuma Marine Corps Air Station (Ariz.) currently ranked first and the Naval Weapons Center, China Lake, (Calif.) second. □

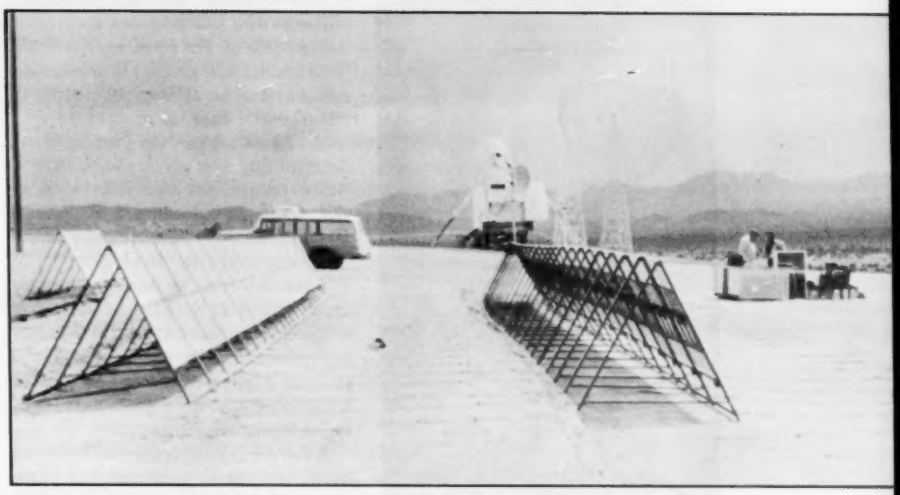
Photovoltaic Power Systems

Photovoltaic power systems (PPS), or solar cells, hold promise for providing electricity from the sun to present and future applications at Navy shore facilities.

Solar cells are appealing in their simplicity. Energy is intercepted by a doped semiconductor disk, electrons are displaced and a voltage potential is produced across the surface. By placing appropriate electrodes on the front and back of the device, electrical energy can be extracted.

The program consists of five projected phases of development. Cycle IA systems were purchased directly by DOE for quick installation. A total of 19 units were installed at five Navy and Marine Corps sites. Power was supplied to such applications as radio repeaters, obstruction lights, emergency radios, and navigation lights. Cycle IB systems will be purchased and installed entirely by the Navy. Under this phase, solar cells will furnish power to radar beacons, television cameras, buoy lights, and a flash beacon. All told, 17 power units will serve four applications.

Cycle II covers 16 various applications including VHF repeaters, an instrument site, transportable power, FM repeaters, a remote ground station, portable meteorological stations, and arresting gear. The applications of approximately 30 units will be evaluated for cost effectiveness. Cycle III deals with larger applications but still supported by diesel power. Of special interest are remote village and water pumping applications.



A TEST ARRAY of photovoltaic systems powers a test Triple A radar set at Randsburg Wash Facility, Naval Weapons Center, China Lake, Calif.

Cycles IV and V also will involve larger applications connected to a commercial power grid (distributed loads). Cycle IV, as now planned, will concentrate on residential housing demonstrations while Cycle V will focus on commercial load centers. Many Navy sites are expected to provide good distribution loads for Cycle V.

A principal goal of the DOE photovoltaic program is to establish a large and vital photovoltaic industry capable of providing a significant amount of solar-derived electrical energy at competitive costs. The purpose is to reduce reliance on petroleum-based fuels.

The ultimate objective of the DOE program is to lower the cost of cell modules to $2 per watt by 1982 and 50 cents per watt by 1986. Presently they cost $10-$15 per watt. The Navy, DOE and industry agree that the objective is reasonable and valid using existing technology. □

Dissolved Salt Energy Battery

Successful performance tests have been completed at the Civil Engineering Laboratory on a dissolved salt energy storage unit (battery) that heats domestic water and living areas.

The in-house acceptance tests proved so encouraging that the contractor who built the original test unit for the laboratory plans to commercialize the unit. The company is manufacturing six units of various sizes and different salts which melt at their respective temperatures.

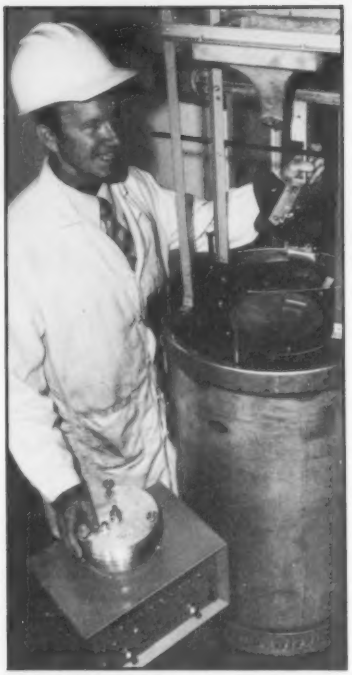
The CEL experiments proved that the problem of salt crystallization on heat transfer surfaces has been solved. In the past, during the phase change (liquid to solid) such units had been characteristically plagued by crystalline deposits which prevented efficient heat transfer.

A new method using immiscible liquids has overcome the obstacle and provides constant heat transfer. An enormous direct contact heat exchange surface is generated by the creation of an oil-liquid, consisting of a myriad of tiny droplets. The emulsion is the critical element necessary to achieve the large heat transfer conductance.

The performance tests disclosed that the requirement of 50,000 BTU/hr had been satisfied although higher heat transfer rates were observed. The energy storage unit is capable of storing 100,000 BTU of heat and delivering it at a constant temperature of 138°F. As the molten salt freezes it emits heat. The heat can be extracted at a constant temperature of 138°F, the melting point of the particular salt used in the acceptance tests. The temperature is ideally suited to the use of solar collectors to recharge (remelt) the salts.

Future plans call for the unit to be integrated with CEL's Advanced Energy Utilization Test Bed heating system. The Laboratory intends to publish a contract report this year. □

Air Leakage



FINAL INSPECTION of a pressure vessel specifically designed for testing air leakage is made by Dr. Clarence Winterheimer.

Air leakage through external surfaces of a building can contribute up to 40% of the total energy load. This results in high cost to consumers and waste of an exhaustible supply of natural gas, fuel oil or coal.

A quick, low-cost method of determining the air leakage rate is being researched and developed at the Civil Engineering Laboratory. Dr. Clarence Winterheimer, an electrical engineer from the University of Evansville, (Ind.), during summer employment at CEL, has derived a method to increase or decrease building pressure. He has replaced the door on a seven-cubic-foot autoclave with an annular steel plate surrounding a mylar diaphragm.

An ordinary air compressor driven by a ¾hp motor increases the pressure inside the vessel to a value of 12 psi which is not destructive to the structure when the diaphragm is ruptured. Alternately, a vacuum pump decreases the pressure inside the autoclave to a value of 24 inches of mercury, within safe limits. After the desired pressure is achieved inside the autoclave, the mylar diaphragm is ruptured instantly when cut by a razor-sharp knife. The air inside the autoclave quickly spreads throughout the building, suddenly increasing the pressure within the structure to approximately 0.36 inch of water. Of course, interior air leaking to the outside escapes at a leakage rate determined by the sizes of cracks, crevices and holes in the exterior surfaces.

Air infiltration rates have been effectively measured by using a large 18-inch reversible fan to build up a constant pressure inside a building and then measuring the rate of air flow through external surfaces at the fixed pressure.

Dr. Winterheimer said that a disadvantage of using the fan is the difficulty of achieving instant stoppage of air through the fan duct immediately preceding the elapsed time interval during which the building pressure drops from 0.3 inch of water to 0.1 inch of water.

He also said that it is easier and quicker to push an autoclave-type pressure vessel and a small compressor (or vacuum pump) into a building than it is to install a temporary variable-sized plywood panel containing a built-in fan in an existing door opening. □

Electric Vehicles

A fleet of 50 new commercial mini vans and delivery wagons is being delivered this summer to five selected Navy facilities. They are electric vehicles, the vanguard of units involved in a joint Department of Energy-Navy effort which will run through FY87.

The Navy's electric and hybrid vehicle (E&HV) program calls for the vehicles to operate on various short service runs presently performed by conventional internal combustion engine vehicles (cars, trucks, vans). By testing functions of the experimental vehicles, the demonstration will explore the relief of dependence on fossil fuel.

In 1976, Congress approved the Electric and Hybrid Vehicle Research, Development and Demonstration Act. It established an eight-year project to "demonstrate the economic and technological practicability" of using such vehicles on the nation's highways. As part of the demonstration program, federal agencies have been requested to participate using DOE-funded vehicles in normal fleet operations.

The Naval Weapons Center (NWC), China Lake, Calif., has the responsibility to conduct the electric vehicle program.

Garyl Smith, program manager for alternate energy systems at NWC, said 15 vehicles will be delivered to the center; 10 each to the Naval Weapons Station, Concord, Calif; Naval Ordnance Station, Indian Head, Md; and the Naval Air Training Center, Patuxent River, Md; and five vehicles to the Naval Surface Weapons Center, Crane, Ind. He said that when newer and better vehicles are manufactured, additional units will be obtained by DOE for evaluation in different Navy environments.

The demonstration phase of the program will provide data on performance, acceptability and life cycle costs. This information will help DOE in its efforts to improve E&HV development, manufacturing and marketing. The department requires data in four categories: operations, maintenance, life and cycle costs, and user assessment. Participating facilities possess data collection capabilities to meet these requirements.

Funding for the electric vehicle program will come from three sources. DOE will supply funds for the purchase of vehicles, spare parts, and the required reports. The Navy Energy and Natural Resources R&D Office will provide funding for administration. And each Navy facility involved in the program will provide for the operation and maintenance of the vehicles.

Lighting Systems

Approximately 33% of the electricity consumed annually by the naval shore establishment is for lighting systems. The illumination program at the Civil Engineering Laboratory (CEL) is considered an important part of its energy conservation program.

While contributing to the saving of energy, the quality of lighting should be maintained or improved. Energy conservation through better lighting systems involves a complex process which includes physics, engineering, psychology, physiology, aesthetics, and economics. Lighting systems cannot be treated independently of other building systems since intricate relationships often exist with heating, ventilation and air conditioning systems.

CEL is the focal point in the Department of Defense's plans to conserve energy through improved and more economical lighting systems. The laboratory has concentrated its efforts on two recently developed lighting parameters: equivalent sphere illumination (ESI) and visual comfort probability (VCP).

William Pierpoint is the principal investigator for electrical conservation in CEL's energy program office. He explains that ESI is a measure of visibility. It is the equivalent level of illumination required inside a photometric sphere that equals the level of illumination in the real environment. Just as the markings on a ruler measure the lengths of several objects, the illumination inside the photometric sphere measures the visibilities of several different lighting systems.

ESI is sensitive to both the intensity and direction of the light. For example, an improperly located fixture will increase the amount of lighting but still would reduce visibility because of veiling reflections off the work surface. By understanding the proper relationships between intensity and light direction, it is possible to reduce the intensity (saving energy) and still provide the same visibility.

VCP is a statistical rating system that determines the percentage of people who would not complain about glare produced by lighting in a space. In a drafting area illuminated in a traditional but ineffective manner by placing rows of luminaires on the ceiling, the VCP is about 50 which means that half of the employees would complain about the glare. This type of lighting has led many persons to dislike fluorescent lamps. On the other hand, a reception area properly illuminated with a combination of direct and indirect lighting, with the luminaire directly above the worker's head, has a parabolic louver which virtually eliminates all direct glare. The VCP is approximately 95 which means that few individuals would complain about the glare.

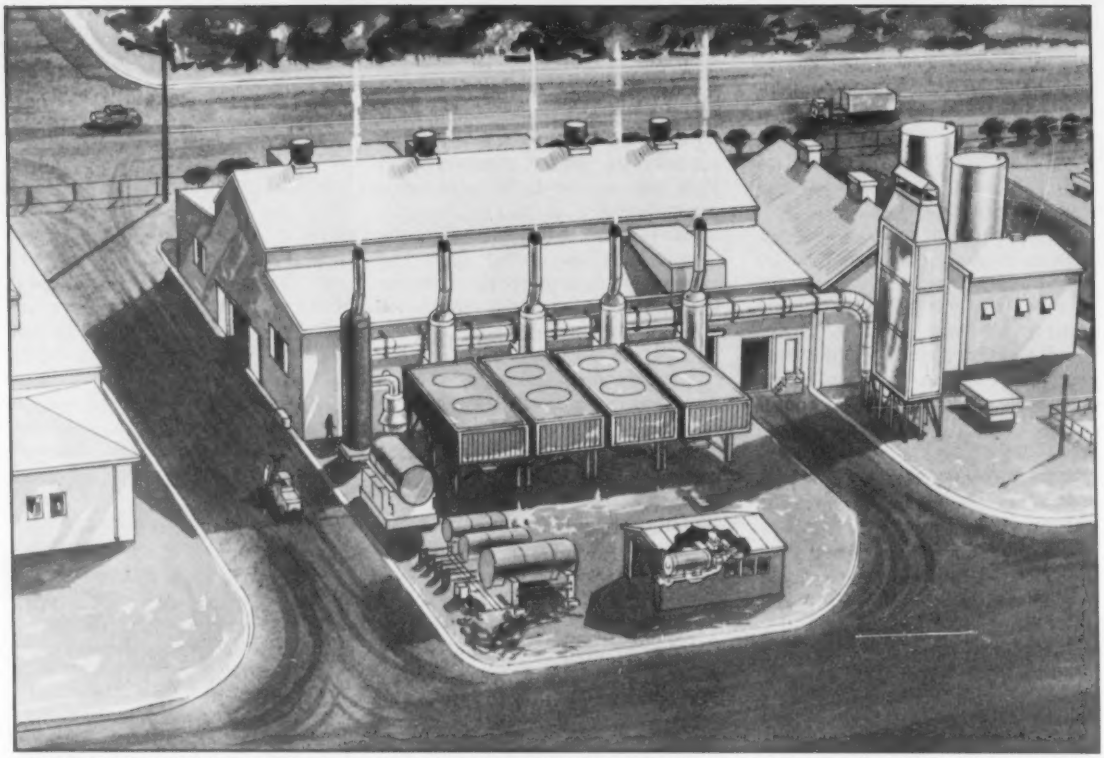
The CEL lighting program is designed to help users utilize ESI and VCP at both the engineering field division (EFD) and public works (PW) levels. A four-day lighting workshop was held at CEL for EFD design engineers. They were introduced to ESI and VCP methods and learned how calculations can be made.

For the public works level, CEL is developing methods to illustrate practical techniques for adjusting light levels and minimizing veiling reflections which affect ESI. Public works engineers can determine VCP from tables available from luminaire manufacturers. Programmable calculator programs are being developed for life-cycle costs, daylight evaluation, and the ESI from job site lighting. A lighting controls handbook with various lighting controls refitted under the Energy Conservation Investment Program (ECIP) is also being developed by CEL.

A variety of laboratory lighting projects will give Navy engineers new methods to conserve energy and to improve visibility and visual comfort. □

TRADITIONAL lighting for a drafting area produces complaints from about half the employees.

A RECEPTION AREA illuminated with a combination of direct and indirect lighting produces few complaints from employees.



THE ORGANIC RANKINE cycle bottoming system to be installed at NAS Bermuda will reduce oil consumption 10%. In this drawing, the five vertical mufflers are shown in front of the building housing five large diesel engines. Directly behind the mufflers is a four-foot diameter manifold pipe which carries the exhaust gases (usually expendable) from the engines to a vapor generator at the far right. The generator boils the organic working fluid and converts it into high pressure gas. The gas is then transferred underground to an equipment shelter, in the foreground. A combination of turbine, condenser and generator takes the energy from the gas and produces electrical power.

Recycling Exhaust Gases

A $1 million interagency agreement between the Navy and the Department of Energy has been signed to purchase and install an organic Rankine cycle bottoming system (ORC) at a diesel electric power plant at NAS Bermuda.

The Navy will manage the project as a tri-service activity under its Department of Defense-designated role as lead service for cogeneration/total energy technology. The Naval Facilities Engineering Command's (NAVFAC) Atlantic Division is contracting agent for the project. The Civil Engineering Laboratory (CEL), Port Hueneme, Calif., is acting as technical consultant and will consolidate total funding support.

Installation of the system should begin next fall and start up is scheduled for January, 1981. When operational, the system will reduce oil usage 10% at the naval air station. The Navy will study the maintainability, reliability and safety of the demonstration project. Engineers want to learn if the system is compatible with a military environment and its particular operating requirements. The system will cost approximately $650,000 and installation is estimated at $350,000.

If successful, it could be the prelude to the installation of eight other ORC systems (for a total of nine) at naval facilities. Yearly savings in fuel are projected at 70,200 barrels. CEL estimates that the $6.5 million installation package could achieve life cycle savings of $18 million. An economic analysis indicates a total annual savings of $1.18 million. Payback periods range from 4.9 years to 7.5 years.

The Department of Energy wants to promote commercialization of ORC systems for use at industrial sites, municipal power plants and defense bases. It has determined that the 500 KW bottoming system is the best size for commercial use.

Large diesel engines today (those used by utilities to generate electrical power) have 35% efficiencies; consequently, 65% of the energy value of diesel fuel is wasted in cooling operations or rejected as exhaust heat.

CEL studies reveal that the use of a bottoming system at a large diesel-electric power facility could reduce plant fuel consumption by 10%. At 1979 fuel prices the system would pay for itself in approximately six years. (©Graphics by Volk Corp.) □

Base Operating Support Services Contracting

By CAPT C. J. GIBOWICZ, JR., CEC, USN
P.E., FLA. & MASS.
Public Works Officer
U.S. Naval Base

● Guantanamo Bay, Cuba

The Naval Facilities Engineering Command has recently announced the award of a second base operating support services (BOSS) contract. With the increasing reduction of station forces and the directed migration to contracting, it may be of interest to review the BOSS contract. In particular, some history and information on NAVFAC's first comprehensive BOSS contract may be interesting.

The recent award by the Southern Division NAVFAC of a support services contract for Kings Bay, Georgia follows the first such contract awarded in August 1977 by the Western Division for the Trident Submarine Base (SUBASE) Bangor, Wash. In light of OMB Circular A-76, the military services are increasing their contracting of services traditionally performed in-house. It was in this kind of environment that the SUBASE Bangor new home for the Trident Weapons System, was commissioned.

Prior to commissioning SUBASE Bangor, a planning study was conducted to determine base support requirements, organization, and staffing. The study concluded that there was a preference, on a cost basis, for contract support. The study further indicated that additional savings could be expected from a single contractor for support services rather than awarding numerous smaller contracts. Based on this study the Trident Systems Project Manager recommended and the Assistant Secretary of the Navy (Installations and Logistics) approved the use of a single base support contractor.

In November 1976 NAVFAC was requested to develop a contract to provide public works and other services for the new submarine base. NAVFACENGCOM has extensive base maintenance and service contracting experience. For example, in addition to the multi-million dollar military construction program, over 3,000 services contracts, totaling more than $100 million, were awarded in 1976. Notwithstanding, the first BOSS contract was to be a new experience. No major naval shore activity within the continental U.S. was receiving major support by contract.

The proposed contract was to include a variety of functions, many of which were not considered as NAVFAC-type functions. Because of this, a special effort was needed and therefore, a task group was established to search for an appropriate contract type; oversee the development of the specifications and other contract requirements, and take necessary action to achieve award by a target date, August 1977.

The special NAVFAC group explored beyond NAVFAC's own experience. Information was sought from other government agencies, both military and civil. After review of all information and consideration of alternatives, it was decided that the best way to achieve the desired goal, considering the critical support requirements and dynamic situation at SUBASE Bangor, was with a *Fixed Price Incentive Firm Target (FPIF) Contract.*

The FPIF Contract

The FPIF Contract is a flexible contract with incentives to control costs. An adjustable sharing formula provides for both the Government and the contractor to share in cost savings and conversely to share in the burden of overages. The share ratio established is dependent on the Government's ability to define the work scope and other factors. In view of the unusual situation at the SUBASE, with new facilities under construction, a rapidly growing base population, and little workload experience, a significant share of the responsibility was decided to be borne by the Government.

A share ratio of 80:20 and 85:15 was established so that the Government obtains 80 percent of any savings in cost under the targeted cost and conversely pays 85 percent of the costs in excess of the targeted cost. Similarly, the contractor's targeted profit will be proportionately increased or decreased.

Specifications

Development of specifications could not commence until the type of contract was decided upon. Once this decision was made, the next effort was "spec" development and a different approach to contract specifications. With a tight time schedule, the complexity and diversity of functions involved, changing conditions, and lack of historical data, it was difficult to develop detailed specifications.

Further, NAVFACENGCOM was desirous of taking full advantage of industry experience, up-to-date equipment and techniques, and to encourage contractor management innovativeness. This led to the use of *performance specifications.* These tell what the objectives are, the end product desired, and allows the contractor to determine *how* to achieve those ends.

In some cases, performance requirements could not be forecasted and in these cases, responsibility could not be assigned to the contractor. Where performance specifications could not be used, *level of effort* (LOE) *specifications* were used. These specs indicated numbers of manhours, quantities of service, and/or products against which work orders were to be issued. The con-

(continued next page)

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tractor is relieved of the responsibility to determine resource requirements under the LOE specs and Government responsibility is increased since efficient use of the banked level of effort is up to the Government.

The third type of spec used is *watchstanding*. Here, for example, the number of security posts, minimum utility watch requirements, and fire protection crew sizes is specified. These specs are a modified performance type.

Extension Options

The cost reduction incentive of the FPIF was previously mentioned. On a short term basis, this could act as an incentive *not to do work*. For work quality, the Government is very dependent on a contractor's integrity and desire to maintain a good reputation. However, there is also a built-in incentive to do quality work — the extension option. A contract option period of *four years* was deliberately established to provide incentive for responsiveness and quality of performance. This provides motivation for the contractor to perform well, i.e., to persuade the Government to exercise successive *negotiated* options after the initial competitive award.

Obviously a contract of the scope and size of the Bangor contract (over $15 million) required a reputable, experienced firm and therefore the contractor selection process is important. Performance and payment bonds were used on this contract but are of questionable value with a selection process of this kind. The selection process involved a three tiered procedure; *technical evaluation, integration,* and *source selection.* The technical evaluation was accomplished by technical/capability evaluation (TECH EVAL) teams comprised of highly qualified experts in the various functional areas.

Following the technical evaluation, an integration committee reviewed the proposals and the quality points assigned by the TECH EVAL teams. The integration committee assured the existence of proper interfacing between functions and varied interests. Then, the source selection board (SSB) disclosed the price and calculated the cost/quality ratio. The ranking of proposals by cost/quality ratio usually establishes the proposal having terms most favorable to the Government. At times, as in the case of the SUBASE contract, negotiations are held with the proposers prior to final selection.

Contract Jurisdiction

Mention has been made of the variety of functions included in the Bangor contract, including many "non-NAVFAC functions". Included are family housing maintenance, custodial services, grounds maintenance, maintenance of ground structures, pest control services, utilities maintenance and operations, transportation maintenance and operations, solid waste disposal, street sweeping supply, mess attendant services, BEQ/BOQ management, guard mail services, ADP services, public works engineering, crane operations, building and structures maintenance, fire protection services, and security.

Because of the diversity of functions involved, a jurisdictional question was raised during contract development. It resulted with the Chief of Naval Material establishing a policy for consolidated service contracts, such that the Navy System Command having the predominant amount of work to be contracted would be the contracting agency. For the Bangor BOSS contract, at the development stage, 67 percent of the effort was public works related, 11 percent supply, and 22 percent other functions.

Small Business Participation

There is little doubt that the single contractor concept is most effective from a responsive and cost standpoint. Greater coordination can be effected by a single contractor exercising control over all the functions rather than having numerous contractors acting independently. There can be an interchange of personnel and a single point of contact.

However, in assembling a single package contract, appropriate consideration must be given to small and minority businesses and applicable procedures meticulously followed. In the SUBASE contract, provision was included requiring the prime contractor to subcontract a specific amount of the contract to small and minority businesses. In the case of the Bangor contract, award was made to a large firm; however, it is noted that the Kings Bay contract went to a small business.

Surveillance vs. Inspection

Trained surveillance personnel, or technical representatives (tech reps), are essential. The tech rep concept is borrowed from the Air Force. Obviously, NAVFAC does not have in-house expertise in areas such as security, BEQ/BOQ management, messing, etc. At SUBASE Bangor, it was arranged to have the commanding officer detail tech reps from other departments having the necessary expertise to the NAVFAC officer in charge for contractor surveillance.

In this way, any function can be contracted and adequate surveillance provided even though NAVFAC may not have the in-house technical expertise. It is important to note that this type of contract requires *surveillance* as opposed to *inspection.* A close and detailed inspection of the Contractor's effort, tending to concentrate on how the work is accomplished, is to be avoided. Too much inspection will cause a shifting of responsibility from the contractor to the Government.

Technical Library

In using performance specifications and expecting contractor management, reference documents must be made available to the proposers during the proposal development period and to the contractor once the contract is awarded. In defining to the contractor the end product and results desired, without indicating how the objective is to be achieved, the contractor must be able to determine the constraints involved, the criteria by which his performance will be judged, and applicable standards, regulations and guidelines.

The base contractor must be in compliance with those same regulations appropriate to an in-house workforce. For example, in assigning full housing maintenance responsibility to a contractor, he must be aware of statutory limitations and

the detailed cost collection requirements. Since varied functions are involved in a comprehensive services contract with numerous applicable reference, a centralized repository is most practical — i.e., technical library. This library also contains such items as master plans, drawings of facilities and utilities, equipment lists, etc. The maintenance of such a library is made a requirement of the contract.

Where to From Here?

The SUBASE Bangor Public Works and Services Contract was placed into operation on 1 October 1977. Currently there are approximately 1,000 contractor employees providing a full range of services. It is still too early to pass final judgment on the BOSS contract operation at Bangor, however, it can be said that the contractor's management is good and work quality is not unlike that obtained from an in-house work force. A good cost comparison is yet to be made.

Regardless, if personnel reductions and emphasis on contracting continue, more and more of such contracting will be required. The King's Bay (Georgia) contract is patterned after the Bangor contract. Although both Bangor and Kings Bay were prime candidates for contracting because they are new bases requiring an expanding work force, other established shore facilities are also being looked at for possible conversion to contract. If contract support services are desired or required for whatever reason, the Bangor and Kings Bay experience indicates a NAVFAC capability to obtain base operating support services effectively. □

Okinawan Hand Out

By A. SANTANA, EQCM, USN (Ret.)

While constructing facilities at Camp Hansen, Okinawa, in 1963-64, specifications called for several hundred yards of coral for building foundations. The only government-owned coral was at the opposite end of the island, a distance of 25-30 miles, and the young chief assigned to the project visualized every dump truck available in an around-the-clock operation to meet construction schedules.

This prompted him to look for another source of coral as he had done in 1949. At that time the island of Okinawa was under U.S. occupational forces and finding coral on a coral island simply meant clearing the overgrowth and digging in.

The young chief did locate a coral pit very close to the Camp Hansen project. Finding the owner was easy, as he 'just happened' to arrive while the chief was inspecting the site.

Negotiations began right away. The chief could speak a little Japanese, and the Okinawan could speak a little English. He was able to make a fantastic deal. A four-yard load would cost the Navy just $2.00.

The chief was very pleased with his deal as he saved his outfit potentially thousands of dollars on equipment transit time and operational expense.

The Okinawan with whom the chief had negotiated was taken to the Battalion Operations Officer who checked out the 'contract' and instructed the supply officer to arrange for payments. The coral haulings quickly began.

Things went just great and soon the project was near completion, when unannounced a young Okinawan and her father showed up at the base looking for "the chief in charge of coral hauling."

It turned out the Papa-San present was the rightful owner of the site. The chief had negotiated with a claim jumper!

The chief immediately called the operations officer and said, "Sir, *you* bought a coral pit from the wrong Papa-San, and the real Papa-San is pretty furious, so I'm sending him and his interpreter daughter to see you so you can straighten it all out . . . Sir."

The chief saw tons of coral transported into the Navy's cash register with that machine spewing out a stream of dollars into. . . the wrong pocket. He also saw an irate operations officer and knew where wrath would fall.

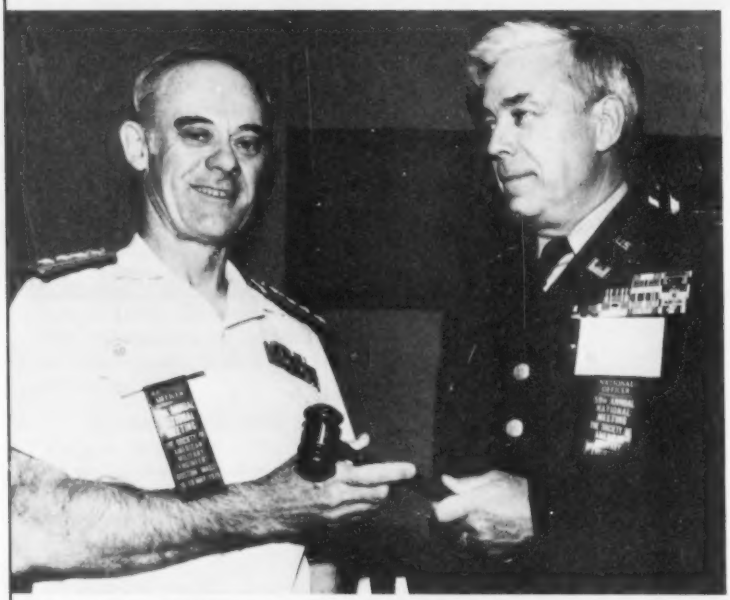
The chief managed to stay away from the operations officer for several days, until his fallout meter indicated "safe."

The confrontation with the true owner of the coral supply turned out to be anti-climactic. True, he owned the site. True, he knew that the entrepreneur had sold the Navy *his* coral for $2.00 a load. But the schemer had promised to pay the owner 50 cents a load. A small price, yes, for your own coral which was retailed to the Navy at 300 percent profit! The problem, the ancient explained, was not that the wheeler-dealer sold the coral, but that the scoundrel wasn't paying his 50 cents a load. Could the Navy help straighten this matter out?

Indeed, answered a relieved operations officer. It was an easy matter to lean slightly on the opportunistic coral supplier to reimburse the site's owner.

The chief still chuckles about the predicament he managed for his old operations boss. It's heard occasionally that the old operations boss tells the story, too. And undoubtedly recalled by a now-forgotten Okinawan telling how he started on his first million. □

Rear Admiral Iselin To Head SAME



TOP NAVY ENGINEER, Rear Admiral Donald G. Iselin, CEC, USN accepts the presidential gavel from his U.S. Army counterpart, LGEN John Morris, USA, as the new chief executive of the Society of American Military Engineers (SAME) at annual convention held in Boston.

Rear Admiral Donald G. Iselin, CEC, USN, Commander, Naval Facilities Engineering Command and Chief of Civil Engineers, was installed as President of the Society of American Military Engineers (SAME) during the Society's 59th annual meeting held in Boston.

RADM Iselin succeeded Lieutenant General John Morris, Chief of Engineers, U.S. Army, and will serve a term of one year. The position of president traditionally rotates among the engineering service chiefs.

The Society of American Military Engineers is an association representing engineers from all engineering services of the Armed Forces and from fields of civilian engineering practice and industry. The purpose of the society is to increase the engineering potential of the United States particularly oriented to national security.

SAME has a membership of 22,000 members worldwide. It is headquartered in Washington, D.C., and has 117 local chapters and 43 student posts in engineering colleges and universities. □

Former Commander To New Post

● Washington, D. C.

Albert Rhoades Marschall, 58, formerly commander of the U.S. Naval Facilities Engineering Command and chief of civil engineers of the Navy, has been named commissioner of public buildings for the U.S. General Services Administration.

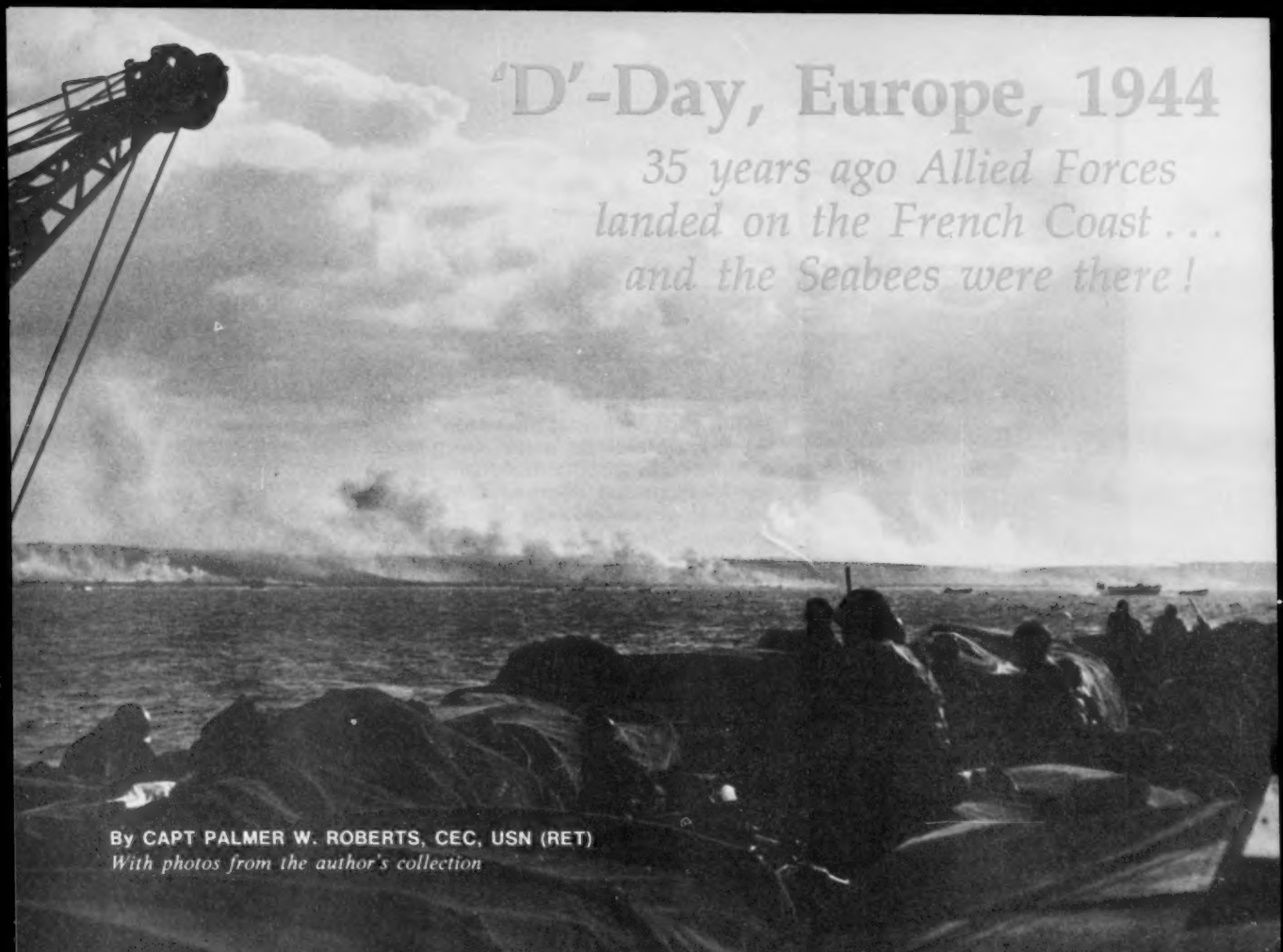
Marschall's appointment was announced by GSA Administrator Rowland G. Freeman III.

"Mike Marschall is a distinguished manager with a fine reputation for facilities engineering planning," said Freeman. "I am pleased to have him join my new management team here at GSA. He will be invaluable."

Marschall, a retired rear admiral, will head GSA's Public Buildings Service, one of the nation's largest civilian real estate operations. PBS manages about 10,000 buildings nationwide, with nearly 232 million square feet, and operates on a $1.4 billion annual budget.

RADM A. R. MARSCHALL, CEC, USN (Ret) former commander of the Naval Facilities Engineering Command is now commissioner of public buildings of the U.S. General Services Administration.

For the past two years, Marschall has been vice president of the George Hyman Construction Co. of Bethesda. The last 10 years of his Navy career were spent in a series of senior executive positions, including commanding officer of the Southern Division of the Naval Facilities Engineering Command with headquarters in Charleston, S.C.; officer in charge of construction in Vietnam, responsible for more than $1.9 billion in military construction in support of the U.S. Armed Forces; and director of the shore establishment division in the office of the Chief of Naval Operations. In the latter position he directed the Navy Department's facilities planning and programming system. □



'D'-Day, Europe, 1944

35 years ago Allied Forces landed on the French Coast . . . and the Seabees were there!

By CAPT PALMER W. ROBERTS, CEC, USN (RET)
With photos from the author's collection

"O.K., let's go!"

The terse announcement by General Dwight D. Eisenhower, supreme commander of the allied expeditionary force, signaled his decision to launch *Overlord*, the invasion of German-occupied Europe on June 6, 1944.

Although marshalling of forces had begun in late May, with an earlier attack date anticipated, poor weather and sea conditions stalled the initial plans. Then, with moderating wind and sea conditions forecast on June 5, the supreme commander made his critical decision that established "D-Day" as the "turning point in history."

Overlord became the first fully developed military operation of its kind and involved over 1½ million troops; 2½ million tons of material; 11,000 aircraft and 5,000 ships and crafts.

Seabee operations during WWII are normally associated with the Pacific Theatre of War where their construction efforts throughout that vast area was truly massive and impressive. However, Seabees and the Civil Engineer Corps were recognized elements in the success of "D-Day," the largest amphibious operation in history.

In a real sense, the invasion for the Seabees began in a bathtub in Virginia in 1939 when CDR John Laycock, CEC, USN, assembled cigar boxes and conceived unique pontoons, the "stepping stones" for the invasion of Normandy. As a result, the pontoon element, a 5x5x7 foot steel box pontoon, was developed at the Naval Construction Battalion Depot, Davisville, R.I. in 1943.

These pontoons, when joined together into a string of seven or more, with longitudinal corner assembly angles and locked by wedge bolts, formed a basic pontoon unit. When joined with similar assemblies they could form a barge, a tug, a landing ramp, a causeway or many other elements needed in beach operations.

Over 22,000 pontoons, produced at Davisville and shipped to England in 1943-44, were assembled into invasion units. Included were 37 rhino ferries, 37 rhino tugs, 56 causeway sections, 12 causeway tugs, 32 causeway blisters, 25 beetles and 57 miscellaneous elements. The 29th Naval Construction Battalion (NCB), the first Seabee unit to arrive in the United Kingdom, relieved the contractors of the construction of U.S. naval bases. The 13th Naval Construction Regiment was formed on September 24, 1943, for the administration and logistic support for the NCBs in the United Kingdom.

(continued next page)

'D'-Day, Europe, 1944

(continued from preceding page)

CHIEF EXHORTS his staff in May 1944. VADM Ben Moreell, CEC, USN, speaks to assembled officers and men at Plymouth, England, of the forthcoming (date unrevealed) assault on the German's West Wall of Fortress Europe.

MASSIVE PAYLOAD of Army tanks is delivered on the Normandy beachhead by the Seabee's rhino ferry. Deck clearly indicates interlocked pontoons.

A typical Seabee rhino ferry with a typical load of vehicles

In mid-December 1943, the 1006th NCB Detachment (possibly the forerunner of the amphibicus construction battalion) arrived from the Mediterranean Theatre. This unit, having assembled and operated pontoon causeways in the invasion of Sicily and Salerno, Italy, was well-versed in the many pontoon problems.

The 25th Naval Construction Regiment (NCR) the largest Seabee organization (nearly 6,000) to participate in the invasion, became ready for the greatest amphibious landing of the war.

Ships and invasion elements departing from the United Kingdom moved toward the converging area, called Piccadilly Circus, the hub where all naval ships and craft assembled. The craft then proceeded through lanes, cleared by mine sweepers, to the five Normandy Beaches — *Utah, Omaha, Gold, Juno* and *Sword.*

The east shore of the Normandy Peninsula had been under heavy aerial attack by Allied bombers. Naval batteries began shelling the beachheads and emplacements immediately to the rear of the beaches and bluffs above.

Landings on the beaches were made almost simultaneously at *Utah* and *Omaha* by U.S. Forces and by British and Canadian Forces at the three beaches to the east, *Gold, Juno* and *Sword.*

Strong winds and high waves created dangerous conditions at *Omaha* beach. At *Utah* choppy waters made landings difficult. *Utah* offered flat terrain while *Omaha* was backed by bluffs and sheer cliffs up to 170 feet high. Heavy anti-invasion defenses had been installed by the Germans at *Omaha.*

Within an hour after the second wave landed at *Utah,* the beach was clear. At *Omaha* the beach was thickly sown with mines, with three rows of tetrahedrons, hedgehogs and tangles of barbed wire to snag and damage invading landing craft. On top of the cliffs guns, strong batteries protected by concrete emplacements, commanded the whole beach expanse. *Omaha* was a giant trap, ready and waiting.

The first LSTs towing five rhino ferries, operated by the 111th NCB, arrived off *Omaha* at 0530 on June 6. The rhinos were cast off and each proceeded to marry its designated LST under difficult wave conditions.

The rhinos proceeded to the beach

Gooseberries, rhinos an

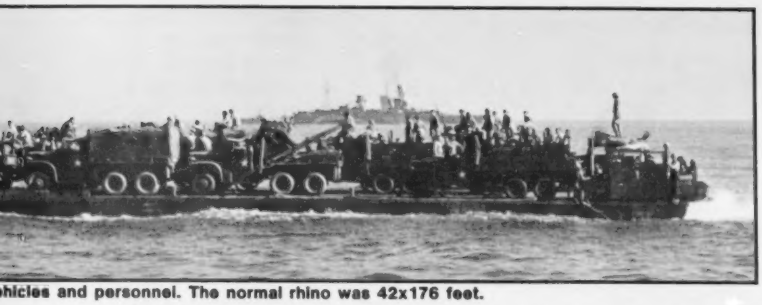
The versatility of the box pontoon, similar to children's Seabee construction of many invasion instruments: drydocks. The British penchant for code names and terminology used in the text includes:

rhino ferries —a grouping of pontoons into self-propelled or towed lighters or barges. A typical Seabee rhino ferry was 42 ft. wide and 176 ft. long and could accommodate 30-40 vehicles, plus personnel and their gear on the deck space.

rhino tugs —power auxiliaries constructed of the basic pontoon and equipped with outboard motors for general utility use.

goose-berries —a line of scuttled ships to create artificial harbors for smaller craft.

BIG PARADE of American troops via a pontoon causeway from small landing craft.



hicles and personnel. The normal rhino was 42x176 feet.

but were held off until beach obstacles were removed. Rhinos engaged in early landings were damaged by mine explosions and subjected to gunfire from enemy shore installations.

During this period 20 rhinos were employed at *Omaha* delivering 14,749 vehicles and 33,091 tons to the beach! Causeways were delivered on June 7 and positioned on June 9.

Mulberry elements arrived off of the beach on June 7, and 14 gooseberries and 35 phoenixes were sunk on the two fathom line forming a gibraltar. Headquarters 25th NCR, then afloat, were established on June 16 in a farm house behind *Omaha* beach.

The first LSTs towing four rhinos arrived early on June 6 in rough seas, completing marriage to other LSTs for unloading. Six more rhinos began operations on June 7. Between June 6-18, *4,307 vehicles and 50,000 tons of bulk cargo* were delivered in 175 trips made by rhino ferries. All were subjected to heavy enemy fire from the beach.

One tug was sunk by enemy dive bombing, resulting in 12 Seabee casualties. The tugs handled 33% of all vehicles unloaded on the beach. A rhino repair barge arrived off the beach on June 7 and began servicing rhino units and other craft.

The pontoon causeways were delivered off the beach on June 7 and a detachment of the 1006th quickly installed two causeways, each two pontoons wide and 2,250 feet long. The camp construction detail of the 81st NCB arrived on June 9 and constructed shelter sufficient to accommodate 1,500 men and 70 officers.

On the morning of June 19 a northeasterly wind arose, the velocity steadily increasing from ten to 30 knots, necessitating the abandonment of all unloading operations on both *Omaha* and *Utah* beaches. Small craft were cast well up on the beach or on the causeways. Gooseberries at both beaches were moved out-of-line or had their backs broken by wave action.

At *Omaha,* larger landing craft of all types collided with bridge units causing extensive damage. Nineteen of the phoenixes, cracked and crumbled, and bombardons, cast loose from their moorings, crashed against the outer harbor elements. The rhinos, although effective in rough seas, were thrown on the beach when the wind increased to 35 knots and with wave action up to ten feet.

STAFF REPORTS to their chief, also in May 1944. Field Marshal Wilhelm Keitel, chief of Germany's combined general staff (second from right) hears of West Wall defenses from local commanders.

MASSIVE DESTRUCTION resulting from heavy storm of June 19, 1944, was too late to impede the success of the Allied landing.

and beetles?

ldren's building blocks and their imaginative use, led to onts: ferries, tugs, causeways, breakwaters, and even s and acronyms was adapted by the Americans. The

phoenix —concrete caissons towed to location sites and flooded to form permanent barriers as breakwaters for artificial harbors.

mulberry—a great artificial harbor created for **Omaha** beach. It encompassed use of gooseberries, phoenixes and **bombardons** (steel fabricated floating breakwaters).

whales —steel truss multi-span bridge installations serving as piers.

beetles —supporting floats of the **whale** bridge created from the versatile pontoon.

DEJECTED PARADE of captured Germans cross the beach to evacuation craft.

The storm subsided on June 22. Limited unloading was begun on both beaches, which were cluttered with debris and craft of all descriptions. Working parties were organized to inventory damage, to clean up the beaches and salvage operative units. About 500 craft were counted scattered on the beaches.

By June 22 the beach was sufficiently cleared to allow LSTs to dry out and unload. Seven rhinos were in service with the remaining awaiting replacement engines from U.K. Both causeways were in operation by June 23, unloading troops and cargo from LCMs and LCTs. Over 15,500 personnel, 3,300 vehicles and 12,000 tons of bulk cargo were landed over the beach on June 24, a remarkable recovery and surely a great credit to the ingenuity and resourcefulness of the Seabees involved.

As a direct result of enemy action during the invasion the Seabees of the 25th NCR suffered 21 dead, 3 missing, 61 wounded and 10 injured. An additional 45 men were incapacitated through injuries not attributed to the enemy but from other sources, i.e., ship and shore accidents, etc.

Following the invasion and storm recovery period, Seabee activity on the beaches primarily consisted of the operation and maintenance of rhino ferries and tugs, causeways and beach camps. Such activity was conducted around the clock with rhino crews standing 48-hour on and off watches. Small crew accommodations were provided on each unit for this purpose.

Commanders Of Seabee Units

25th NCR
CAPT C. W. Coryell, CEC, USN
111th NCB
CDR D. C. Jardine, CEC, USNR
1006th NCB Det.
LT A. M. Zak, CEC, USNR
108th NCB
CDR E. T. Collier, CEC, USNR
146th NCB
CDR E. H. Gessner, CEC, USNR
28th NCB
LCDR J. H. Kopp, CEC, USNR
114th NCB
CDR E. G. Kaltenbach, CEC, USNR
69th NCB
CDR F. N. Walsh, CEC, USN

The landings on the beaches of Normandy did not conclude the Civil Engineer Corps and Seabee operations in the European Theatre of War. Following the successful assault, the Corps and Seabees were engaged in port restoration and maintenance throughout the channel area. And later, Seabees were among the first in the successful crossing on the Rhine River, which brought the war to Germany's homeland and a rapid conclusion to the war.

Official recognition of the 25th NCR's participation in the D-Day landings was expressed late in 1944 by Adm. Harold R. Stark, USN, then Commander, U.S. Naval Forces, Europe, and later Chief of Naval Operations:

"The activities of the 25th Naval Construction Regiment were efficiently carried out under more than ordinary handicaps, such as late start, changes in plans, necessity of developing new methods of operation while a large construction program was in progress, adverse weather and enemy opposition during the early days following the landings on the coast of France. The leadership, skill, and craftsmanship of the regimental and battalion commanders and officers attached was of the highest order, and it was chiefly through these characteristics that so many and so wide a variety of assignments were carried out successfully. The work of the 25th Regiment contributed materially to the success of the landings and build-up of troops, supplies and equipment for the U.S. Armies in France." □

1944

1979

Naval Facilities Engineering Command

SITUATION REPORT

CEC RECRUITING - The Assistant Secretary of the Navy has approved a CEC-Collegiate Program to facilitate the recruiting of CEC officers. It will allow the Navy to recruit college students up to 12 months prior to graduation. Selected students will receive over $700 per month while they complete their degree requirements and will be commissioned in the Civil Engineer Corps when graduated. Officers entering the Corps under this program will have a four-year active duty obligation. An engineering student who is interested in the Collegiate Program should write or call LT David W. Gorden at Naval Facilities Engineering Command, Code 09MB, 200 Stovall Street, Alexandria, VA 22332; (202) 325-0312, Autovon 221-0312. (Also, see inside back cover of this issue.)

(NAVFAC Code 09MB)

COSO GEOTHERMAL DEVELOPMENT - The final date for receiving proposals on the geothermal development at Coso, NWC China Lake, was 26 September 1979. (See page 5.) One proposal was received. The contractor is willing to provide his own capital to further explore and develop the resource at Coso, and to construct and operate a power plant. If successful in the undertaking, the firm would recover its investment through the sale of electricity to the Navy over a 30-year contractual period. The proposal is now being reviewed and, if acceptable, the contractor will be asked later this year to provide pricing on the cost per kilowatt hour of electricity delivered to the Navy.

(NAVFAC Code 111)

1980 SEABEE CALENDAR - The 1980 Seabee Memorial Scholarship Association calendar, dedicated to Admiral Ben Moreell, is now available. The calendar may be ordered by sending a written request with a check for $2.50 (for orders made after 1 December, please add 50¢ to help defray the cost of postage) to: Seabee Memorial Scholarship Association, Inc., P.O. Box 37229, Washington, DC 20013.

(NAVFAC Code 09D)

Prevent Airless Spraying Accidents

A recent survey shows that professional painters now use airless spraying more extensively than conventional air spraying because of the more uniform application of the paint in less time with less overspraying. This results in significant lower painting costs.

The high pressures (as high as 4,000 psi) associated with airless spraying pose a potential hazard to users. The paint can penetrate the flesh with serious results — amputation of hands or fingers, either from the direct-impact injury or the toxic effects of the paint.

Accidents most frequently occur during the wiping of gun tips or their removal for cleaning. The injured person may feel only a pinprick (possibly with no loss of blood) in spite of serious tissue damage, which may subsequently lead to amputation.

To prevent accidents with airless spray equipment, the Consumer Product Safety Commission has ruled that all airless spray guns sold must be equipped with guards to keep hands away from the tip. A recent Civil Engineering Laboratory survey revealed that Navy painters often remove the tip guards from the guns because the guards may cause dripping and spitting of the paint resulting in uneven application. Because of the dripping, painters tend to wipe off the guard close to the spray tip, which is also unsafe. Some painters thought the plastic tip guards were there to protect the tip of the spray gun rather than the user.

To prevent injury, users of airless spray equipment must be made aware of the serious hazards associated with the equipment. Several recommended practices will minimize these hazards.

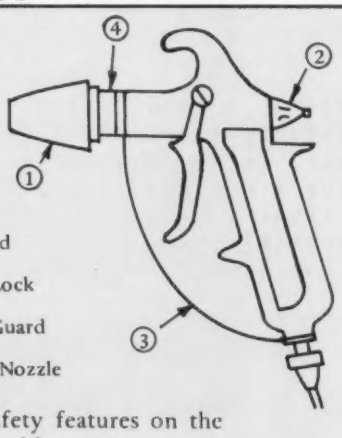
Painters using airless spray should:

- Be well trained in equipment use.
- Never put a hand or fingers in front of the spray gun.
- Never point the gun at a body.
- Never work on or repair the equipment when it is under pressure. The equipment must be shut off, the pressure released, and the trigger safety engaged before disassembly. *Shutting off the power does not release the pressure.*
- Always secure connections to prevent leaks.
- Never spray a flammable solvent through the gun tip. The high velocity generates static electricity which could cause a fire or explosion.
- Never spray in closed areas without adequate ventilation.
- *Never spray in the presence of open flame.*
- Never store flammable materials in the spray area.
- Never allow an untrained person to use the equipment.
- Never plug a hose leak with a finger.
- Wear protective gloves and goggles at all times.
- Remove the tip guard only where spraying with it in place is impossible.
- Never leave an airless spray unit unattended while it is under pressure.
- Always remove the gun from the unit after flushing and when storing.
- Think of the airless spray gun as a dangerous weapon and keep the trigger safety engaged when not in use.
- Obtain immediate medical attention for injuries, reporting the nature of injury and the type of fluid or solvent.

The spray gun should have the safety features shown in the drawing. Further safety measure to be observed are regarding the pump unit. The pressure pump must be grounded as well as the electric supply and work pieces. Three-pronged grounded extension cords should be used, and the hose should be checked for leaks, cuts and wear before use. Any damaged hose should be replaced.

Warning signs for airless spraying and "No Smoking" signs must be displayed prominently in the work area. All electrical equipment and the airless spraying work areas must conform to the requirements of the Occupational Safety and Health Administration (OSHA).

Additional information may be obtained from Eddy Matsui, Code L52, Civil Engineering Laboratory, Naval Construction Battalion Center, Port Hueneme, CA 93043; Autovon 369-5340. □



① Tip Guard
② Trigger Lock
③ Trigger Guard
④ Diffuser Nozzle

Safety features on the airless spray gun.

Capital Improvements For Pacific Trust

By LYLE W. JONES
Assistant Division Director
Federal Agencies, NAVFAC HQ

● Alexandria, Va.

Among the last nations produced by United Nations trusteeships will be three new sovereignities in the Western Pacific. They are Palau; the Marshalls; and the Federated States of Micronesia which include the former Trust Territory districts of Yap, Truk, Ponape, and Kosrae.

Under a 1947 trusteeship agreement with the United Nations Security Council, the United States is responsible for administering the Trust Territory of the Pacific Islands (TTPI). Major objectives include raising living standards of the people and leading them toward eventual self-government upon expiration of the trusteeship which is scheduled for 1981. The TTPI is made up of six regional districts: Truk, Palau, Yap, Ponape, Kosrae and the Marshalls, commonly known as Micronesia (meaning "little islands"). The island groups are of the Eastern and Western Carolines and the Marshall Islands; the scene of many major World War II naval and marine corps actions. The collection of 2,000 tropical islands stretch from west of Hawaii to south of Japan, a vast area covering 3,000,000 square miles with a land mass only half that of Rhode Island. Ninety-seven of those islands are inhabited by some 115,000 people.

In January 1974, the Secretary of the Interior, outlined a five-year Capital Improvement Program (CIP) for the trust territory, amounting to $145 million (in constant fiscal year 1975 dollars) to be appropriated in fiscal year 1976.

The stated purpose of the CIP is to further economic self-sufficiency in the TTPI. The CIP has been developed under two basic tenets: that the United States has the responsibility to bring about the educational, economic, and social advancement of the inhabitants of Micronesia and that of providing the major facilities required to support growth of the TTPI economy.

The CIP was designed to put in place a basic structure for further economic development. The program places emphasis on providing roads, utilities, airfields and harbor facilities in each district. It is planned that this will result in self-sustaining economic centers promoting agriculture, tourism, and potential industries (such as fisheries).

A key consideration in the preparation and development of plans and specifications is optimum construction project packaging. The remoteness of the TTPI and high mobilization and transportation costs dictated the grouping of projects into the largest bid packages practical. Larger bid packages attracted wider bid interest and increased competition by well-qualified firms. Design of the CIP is now about 80% completed. The present schedule indicates that the entire CIP design will be completed by January 1980.

The Officer in Charge of Construction Marianas is administering approximately $50 million of CIP construction. The active projects of the OICC are:

TRUST TERRITORY CAPITAL IMPROVEMENT PROGRAM

Location	Description	Amount ($ Mil)
Truk	Airport	20.0
Ponape	Airfield/Roads/Dock Repairs/Water/Electrical	14.0
Yap	Dock/Harbor	6.0
	Water/Electrical	1.6
Palau	Roads/Water/Docks	5.3
Kosrae	Electrical	.8
	Total	47.7

By the end of fiscal year 1979, $127 million will be under construction or approximately 93% of the funds made available through fiscal year 1979, including FAA and EPA federal related grants. Several of the more significant projects packaged in fiscal year 1979 included the following:

	Estimated Cost ($ Million)
Palau airfield, roads, and utilities	30.0
Ponape airfield, dock repairs and utilities	14.0
Truck roads and utilities	11.0
Kosrae airfield, dock, roads, and utilities	19.0

The Fiscal Year 1980 program of $51.7 million will augment previously appropriated funds in the amount of over $120 million, allowing continuation of work on programs started in earlier fiscal years. Proposed FY81 funding of about $15-18 million will complete the five-year Capital Improvement program at a total cost of about $223 million.

The new nations will have stronger ties to the rest of the world by way of the airfields and docks and be stronger internally by means of roads and utility systems.

The negotiations currently in progress between the United States and the emerging nations indicate that the U. S. will continue a substantial level of economic support well into the 1990's.

In the later spring of 1976, representatives from the OICC and the Department of the Interior visited each Trust Territory District and solicited district administrators and traditional leaders to develop a priority list of projects to constitute the proposed CIP. From these lists, a consolidated program of projects was prepared of the highest priority projects consistent with the $145 million program.

DOTA approved the proposed projects and proceeded with program design in June. One A/E firm was selected to perform all designs within the five districts for which the Navy is the construction agent. By the end of 1976, selection by the Navy of A/E firms for their districts was completed and awards were made in early 1977. The Army Corps of Engineers is the construction agent for the Marshall Islands district and is responsible for design and construction of CIP projects in that district. □

Concerning Contract Disputes

"Good laws lead to the making of better ones; bad ones bring about worse." — Rousseau.

By WILLIAM H. SPECK
Counsel, NAVFAC HQ
● Alexandria, Va.

With the passage of the Contract Disputes Act of 1978 the claims handling procedure embodied in the Disputes clause of most Federal Government procurement contracts has completed an evolution from contract (consensual) undertakings to statute (legislative) procedures, with the consequences still to be learned.

The procurement contract disputes procedure originated in the Civil War, with a provision in contracts making decisions of government officers on certain contract matters conclusive. That procedure was somewhat like arbitration, an agreement of the parties for resolution of differences outside the courts, with the important distinction that an officer of one of the parties (that is the Government) was making the resolution. The legality of an officer from one of the parties making conclusive decisions was quickly challenged and upheld.

Government contracts required determinations of facts and came to provide for Changes and Terminations for Convenience; the Disputes clause procedure resolved differences. During World War I disputes became so numerous that each of the military departments set up boards of officers to hear and decide claims.

During World War II the boards to decide disputes were revised and expanded to handle numerous claims arising during the administration and terminations of contracts. And legal questions again reached the U. S. Supreme Court. In *U.S. v. Moorman,* the court held that a contract could make the decision of the Government officer or board final as to both the law (interpretation of the contract) and the facts; and in *U.S. v. Wunderlich,* it held that these decisions were final except for fraud alleged and proved, conscious wrong-doing or an intention to cheat and be dishonest.

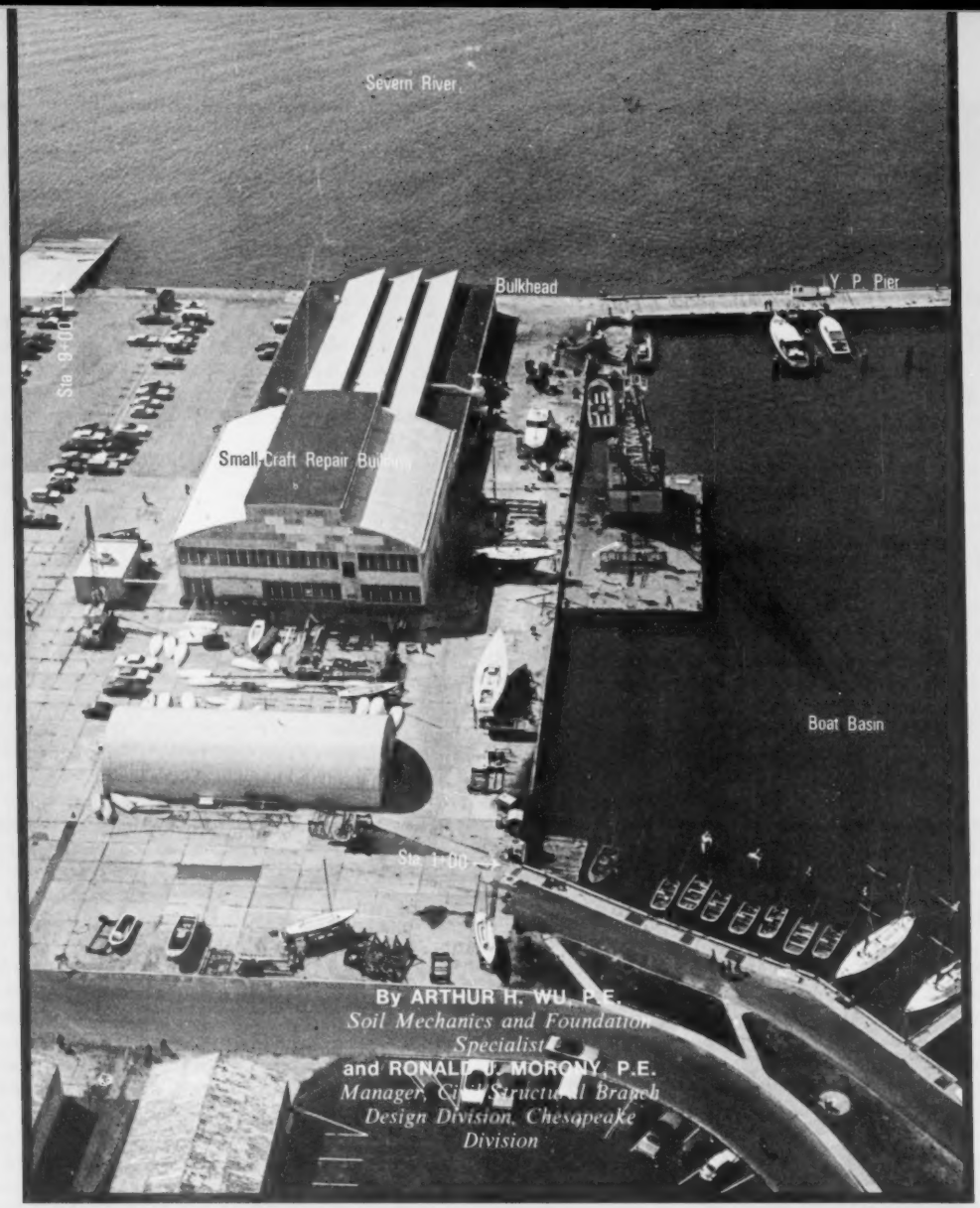
Although the Department of Defense quickly amended its Disputes clauses to limit finality, Congress in 1954 passed the *Wunderlich Act,* forbidding clauses which made decisions final on a question of law and making them final on matters of fact only if not fraudulent, capricious or arbitrary, or not supported by substantial evidence.

Under Wunderlich Act review the Supreme Court continued to decide important issues of procedure and finality. In *U.S. v. Bianchi & Co.,* it held that a reviewing court could not conduct a new trial but must decide on the administrative record, staying judgment if necessary for further administrative proceedings. In *U.S. v. Utah Construction & Mining Co.,* it held that boards could not decide finally disputes not redressable under contract provisions (i.e. for delay damages) and in *U.S. v. Anthony Grace & Sons,* it held that a court reviewing under the Wunderlich Act must either render summary judgment upon the record or remand for additional findings, not try the case itself. In the last highest court case, *S & E Contractors v. U.S.,* the Supreme Court held that a board of contract appeals decision was binding on the Comptroller General and could not (absent fraud) be repudiated by other administrative agencies.

Over a hundred years of court law and one legislative intervention have now been restated in the Contract Disputes Act of 1978. That law established boards of contract appeals, under some control of the Office of Federal Procurement Policy, gives them supergrade members and subpoena and discovery power, and provides for small claims and accelerated procedures.

It further provides that contracting officers and appeal boards may decide all claims under the contract, that courts may review under the Wunderlich Act standards, but that a contractor may choose to by-pass board review and bring action directly in the Court of Claims. District court jurisdiction of contract claims is abolished, appeals must be brought within 90 days, and suits must be brought within twelve months.

A provision provides for recovery of the amount of fraudulent or misrepresented claims plus the costs of its review. Interest on claims found due must be paid at Renegotiation Board rates from date claims filed. Contracting Officers must decide all claims under $50,000 within 60 days and all claims over $50,000 must either be decided within 60 days or the date for decision must be stated. These new provisions will generate new court litigation and perhaps eventually more U. S. Supreme Court Decisions. □



Bulkhead Deterioration and Repair at Annapolis

By ARTHUR H. WU, P.E.
Soil Mechanics and Foundation Specialist
and RONALD J. MORONY, P.E.
Manager, Civil Structural Branch Design Division, Chesapeake Division
● Washington, D. C.

An L-shaped sheetpiling bulkhead, built in 1942, is located in a small-craft repair and boat basin area on the north bank of the Severn River, at the U.S. Naval Station, Annapolis, Maryland. A pier for yard patrol boats (Y.P. Pier) forms the south breakwater of the boat basin and abuts the bulkhead corner.

The bulkhead is composed of Z32 section sheetpiling, double channel wales, steel tie rods, and timber pile anchorage spaced at 2.1m (7 ft.) centers in a line 10m (33 ft.) behind the sheetpiling. Each timber pile group consists of one plumb pile and two battered piles. Pile groups are connected by 5cm (2 in.) diameter steel tie rods to the sheetpiling wale. The top of bulkhead is 2.4m (8 ft.) above mean low water level. The mud line at the face of the bulkhead is 2.1m (7 ft.) to 3.6m (12 ft.) below mean low water.

Soil borings made along the face of bulkhead indicated that the subsoil

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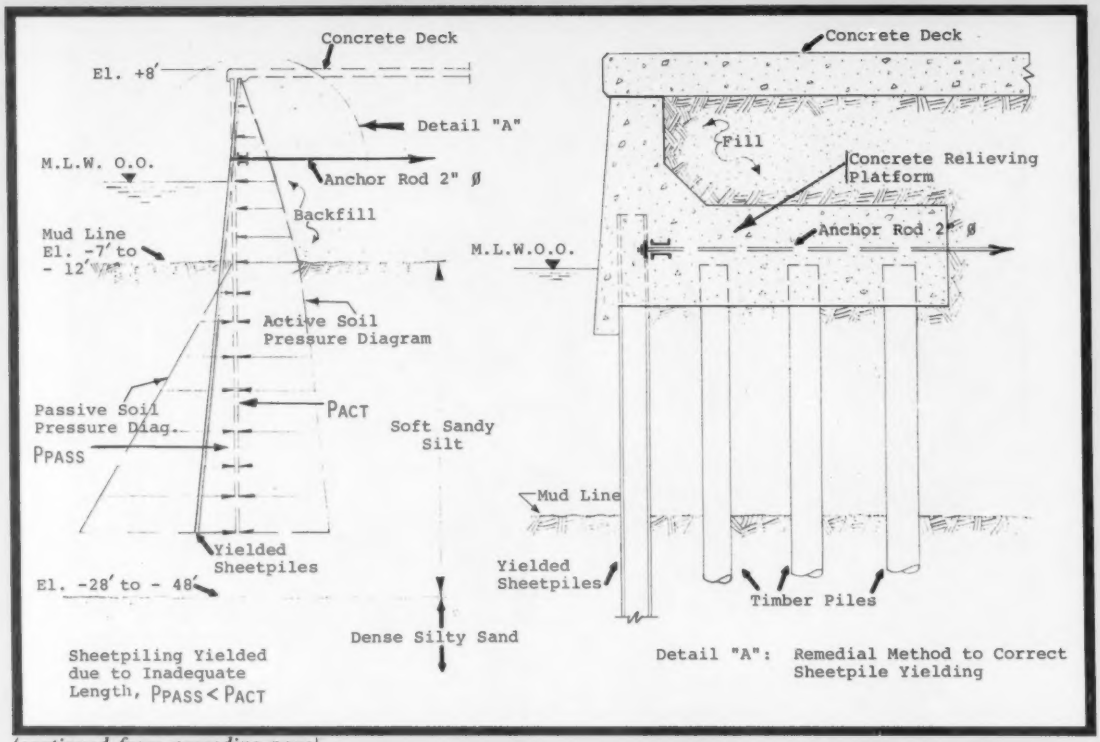

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conditions consist of soft sandy silt to elevation –7.9m (–26 ft.) to –12.7m (–42 ft.), which was over a dense silty sand. The borings also revealed that the toe of the existing sheetpiling was terminated in the soft sandy silt at 0.6m (2 ft.) to 4.5m (15 ft.) above the dense silty sand. This indicated that the length of the sheetpiling was inadequate, which explained why during construction in 1942 about 30 linear meter (100 ft.) of sheetpiling yielded during the placement of hydraulic backfill.

This was caused by the active soil pressures exceeding the sheetpile lateral bearing capacity. The remedial method taken in 1942 was to replace the failed portion with a timber pile supported concrete relieving platform, a very costly solution. The cause of sheetpiling failure and the remedial work are illustrated.

In 28 years between construction in 1942 and 1970, extensive sheetpile damage had occurred. In 1970 and 1974, field investigations were conducted to evaluate the extent of deterioration; causes of deterioration, solutions for bulkhead repair, and methods of preventing future deterioration.

The investigations also revealed three notable points;

- Corrosion of sheetpiling had concentrated in the lower tide range, between El. 0.0 to –0.9m (–3.0 ft.).
- Deterioration mainly occurred on the side faces, webs of the Z sections. The side faces of sheetpiling were originally 0.95cm (⅜ in.) thick while the front and back faces were 1.27cm (½ in.) thick. The rate of deterioration of sheetpiling in the lower tide ranges was at least 0.038cm (0.015 in.) per year, which is relatively rapid.
- The winter tides were generally in the lower tide range.

Deterioration of the sheetpiling followed a clear and consistent pattern. A band of heavy corrosion occurred in the lower tide range or within 0.9m (3 ft.) below mean low water, where honeycomb type holes and large holes developed in about 5 to 70% of the sheetpile surface. Below the low tide range and down to the mud line, corrosion had been relatively light. Corrosion in the upper tide range and splash zone was moderate, and was indicated by a typical reddish-brown rust-colored appearance. At the top of the sheet piles, the framing was heavily corroded. The strength of the sheetpiling was extremely impaired in many areas, and was no longer capable of resisting lateral pressures resulting from the backfill and surcharge.

The fill behind the sheetpiling has been gradually washed through the open holes causing loss of ground and undermining of the concrete deck. Large voids developed and severe collapses of the concrete deck occurred. The service capacity of the facilities had been greatly reduced.

Test pit inspections made in 1970 and 1974 indicated the anchorage, tie rods, and wales to be in good condition. However, it appeared that the rate of deterioration of the sheetpiling and failure of the concrete deck would continue at an accelerated pace.

At the time of inspection, the bulkhead had been in service for about 30 years, thus exceeding its normal life span. No maintenance or repair was made during this period. Repair of the corroded sheetpiling can be made by welding of steel plates or encasement of concrete

panels. But these types of repairs could cause instability of the bulkhead since the sheetpiles had been installed inadequately. Therefore it was determined that a complete replacement of the sheetpiling would be the most practical and cost effective method of repair in this case. A Z-section steel sheetpiling was selected over precast concrete sheetpiling because of the requirements of greater rigidity and connection to the existing anchorage system.

New construction for the repairs included:

- *Steel sheetpiling:* Driving Z27 section sheetpiling parallel to and 1.1m (3.5 ft.) outboard of the existing bulkhead. The length of new sheetpiles varied from 11.5m (38 ft.) to 16.7m (55 ft.) The steelpiling was high strength marine piles with coal tar epoxy protective coating applied on the water side from the top of sheetpiling to one foot below the elevation of the dredged bottom.
- *Anchorage System:* Utilizing the existing anchorages which were in good condition. A double channel wale was attached to the back face of the new sheetpiling at the same elevation as the existing wale. The new and the existing wales were connected with 6.35cm (2½ in.) diameter rods which were of the same alloy as the steel sheeting and were coated with the same coal tar epoxy coating.
- *Concrete Deck Repair:* Cutting and removing the existing concrete deck slab for a minimum distance of 1.2m (4 ft.) behind the existing sheetpiling or to the extent of the void developed below the concrete slab. Pouring a new section of concrete deck to the new sheetpiling.
- *Backfilling:* Filling the voids and spaces between the existing sheetpiling and the new piling with compacted washed gravel and bankrun sandy gravel.
- *Dredging:* The depth along the face of the bulkhead was dredged to a uniform depth of El. -3.7m (-12 ft.) for boat operation.

Since continuous operations were necessary for these facilities and the adjacent Y.P. pier, temporary relocation of the facilities, utility lines, and access was made during the construc-

tion period. About 244 linear meters (800 ft.) of the deteriorated bulkhead located adjacent to the small-craft repair building (Station 1+00 to Station 9+00) was replaced in 1976. Repair of the bulkhead beyond Station 9+00 is expected to be made at a future date.

To prolong the life of the new bulkhead, a maintenance program may be implemented to prevent or reduce the rate of deterioration of the sheetpiling. The maintenance scheme is primarily to arrest future deterioration of sheetpiling at the sections where corrosion will occur. Prevention of corrosion can be accomplished

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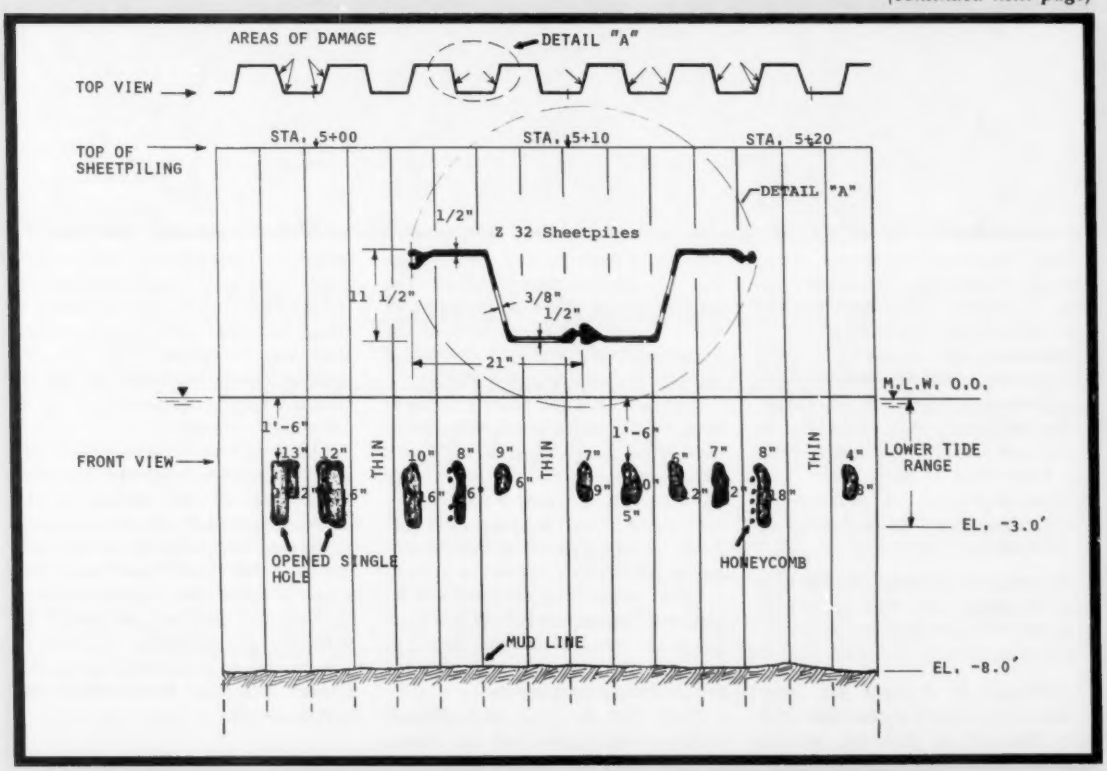

Bulkhead Deterioration

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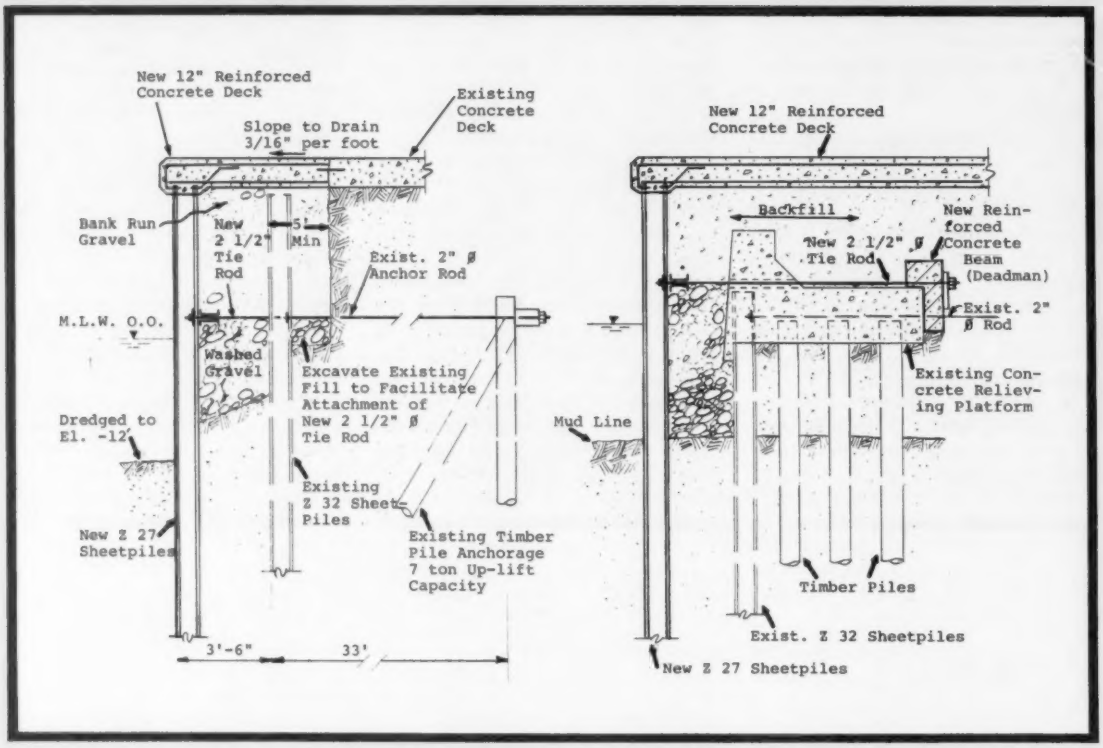

New 12" Reinforced Concrete Deck
Slope to Drain 3/16" per foot
Existing Concrete Deck
Bank Run Gravel
New 2 1/2" Tie Rod
5' Min
Exist. 2" ø Anchor Rod
M.L.W. O.O.
Washed Gravel
Excavate Existing Fill to Facilitate Attachment of New 2 1/2" ø Tie Rod
Dredged to El. -12'
Existing Z 32 Sheet-Piles
New Z 27 Sheetpiles
Existing Timber Pile Anchorage 7 ton Up-lift Capacity
3'-6"
33'
New 12" Reinforced Concrete Deck
Backfill
New 2 1/2" ø Tie Rod
New Reinforced Concrete Beam (Deadman)
Exist. 2" ø Rod
Existing Concrete Relieving Platform
Mud Line
Timber Piles
Exist. Z 32 Sheetpiles
New Z 27 Sheetpiles

by application of bituminous, epoxy coating, or rust and corrosion preventives. Cathodic protection may be also utilized to prevent corrosion by neutralizing the corroding current and forming layers of insoluble reaction products in the lower tide range.

The bulkhead repair excluding the temporary facility cost about $600 per linear foot in early 1976. The relative economics of providing a maintenance program is illustrated as follows:

Alternate A: Assume the life of a new bulkhead for this particular project is 25 years without maintenance.

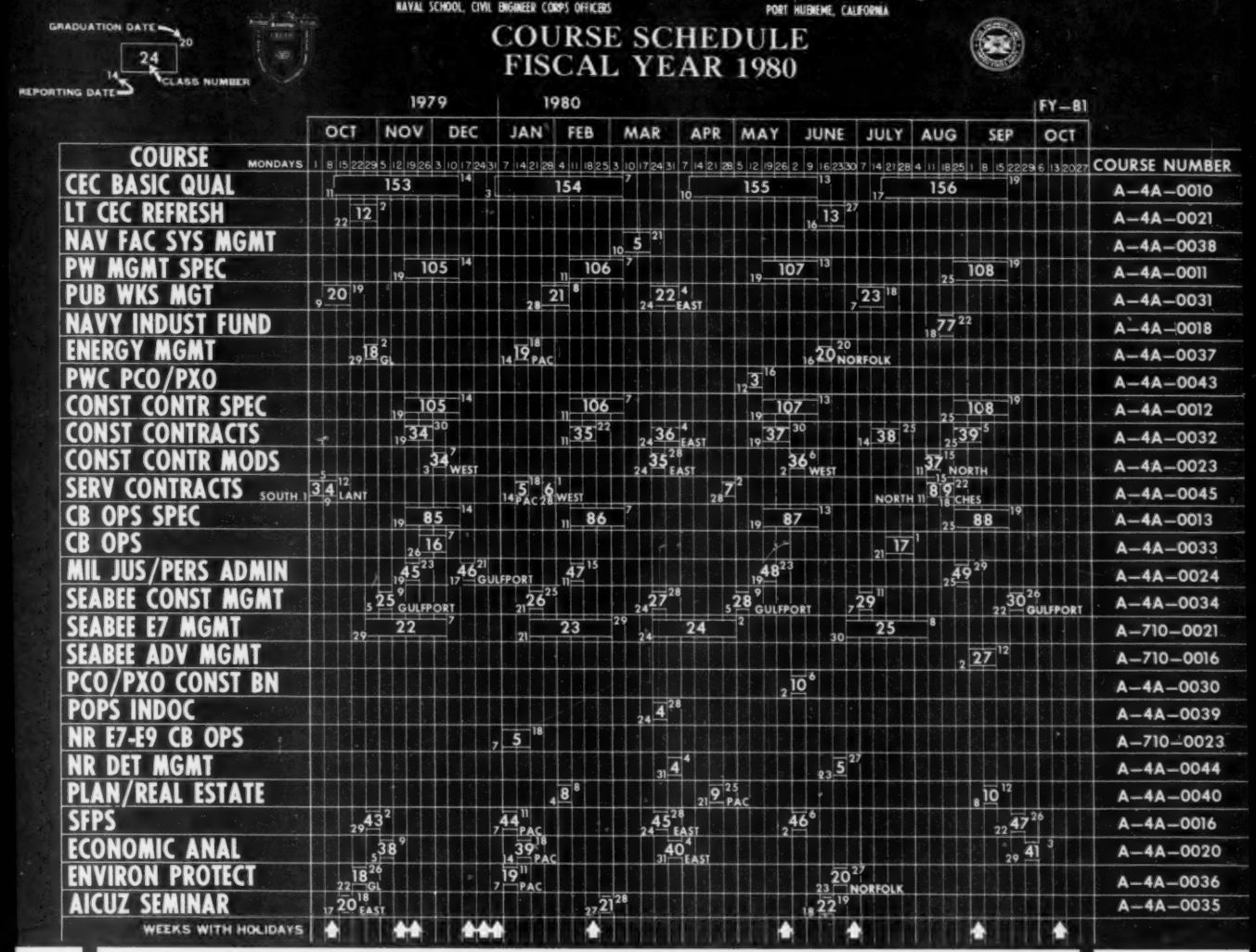
Alternate B: Assume the new bulkhead is properly maintained at 5 year intervals by cleaning, surface coating or protection of the sheetpiling to prevent deterioration. The residual value of the bulkhead at 25 years is assumed to be 50% of the initial total cost, and a 45 year life of the new bulkhead is expected.

Consider that the annual discount rate is 10% and annual inflationary rate is 3%. Then by Present Worth Comparison method, the break-even point for the Alternate B cited above is to spend 5% of the initial total cost for each maintenance. If the maintenance scheme can recover a greater residual value than assumed above, or if each maintenance cost less than 5% of the initial total cost, then it is economically desirable to implement the maintenance program.

From the 30 year-old bulkhead construction records and the recent bulkhead inspections and repair work, conclusions and recommendations can be made. It is desirable to make sufficient soil borings, preferably not exceeding 15m (50 ft.) spacing along the bulkhead line, so that the length of sheetpiles can be accurately estimated.

(This will result in a successful and cost dependable bulkhead construction). The weakest section of the sheetpiling is in the lower tide range in the side faces of the Z-sections and not the front faces. Therefore application of corrosion preventive coating in these troubled sections should be carefully accomplished. It can be economical to implement a maintenance program to prolong the bulkhead life.

□



Professional Enhancement is offered around the calendar at CECOS!

☐ For details concerning courses of instruction refer to CECOSNOTE 1500 (15 Aug 79) available at command training offices or by direct request to CECOS.

☐ Attendance quotas should be requested *in writing* and should include: course number and title; reporting and graduation dates; alternate choice of attendance dates; complete name with appropriate rank, rate or grade with position or job title; business address with Autovon and commercial telephone numbers.

☐ Courses indicated EAST, PAC, NORFOLK etc., are held "off campus" from CECOS with quota control by sponsoring agency and only by special arrangement with CECOS.

For Additional Information
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Naval School, Civil Engineer Corps Officers
Port Hueneme, Calif., 93043
Telephones: (805) 982-5655
AUTOVON 360-5655
FTS 799-5655

Take a closer look at our

Natural Resources

By DENNIS PERHAM
Natural Resources Manager

● Washington, D. C.

A natural resource is a feature of the natural environment that is of value in serving human needs. Besides the obviously "economic" natural resources; minerals, petroleum, water, and timber, all materials that have not been manufactured or processed and all areas that have not been thoroughly and completely developed (such as a New York City block) are natural resources.

Generally speaking, natural resources are all animals, plants, and land areas that have not been paved over, built on, or otherwise modified so as to preclude habitation by obvious nonhuman life forms. Exceptions to this definition include house pets and potted plants. Natural resources include areas that have been modified by people so as to exclude plant and animal life but that are now available for rehabilitation to a more natural state.

Reclamation may occur without human help, but generally people can speed things up dramatically, for example by planting trees on a former sanitary landfill site.

There are three general program areas within the natural resource management program: forest management, fish and wildlife management, and soil and water conservation.

These are interrelated and getting the best results from efforts in one area often depend on making some investment in another area. As an example, for maximum production of upland birds and mammals in Eastern forested areas, a well-balanced forest management program can't be beat. Cutting individual or small groups of trees creates wildlife habitat diversity and "edge." In other words, the environment for wildlife can be infinitely improved and productivity in terms of wildlife numbers and "biomass" per unit of land increased to a maximum. All this in addition to harvesting merchantable timber and improving the growth rates of the remaining trees!

The Secretary of Defense requires that the armed services maintain forest resource management programs. These programs apply scientific management practices and operations to provide for sustained yield of quality timber; watershed protection and management; fish and wildlife; recreation potential; and other resource values including natural beauty. The objective is to maintain desirable biological balance in the forest community.

Most of the larger forested Department of Defense installations (5,000+ acres) have forest management plans and programs. Some of the smaller facilities are somewhat less enthusiastic about forestry but are encouraged to develop management plans. Forest management is the only feasible way to maintain our forested real property and accomplish a wide range of natural resource program objectives. Forestry programs on surprisingly small areas are usually successful if carefully planned by professional foresters sympathetic to the needs of the individual installation.

As with wildlife, forests are renewable resources. Wisely planned timber harvests are as ecologically sound as hunting! Reducing wildlife numbers via hunting salvages "surplus" individuals that may otherwise die. Harvesting older trees and thinning dense young stands of trees accomplishes basically the same thing. Harvesting a reasonable percentage of both wildlife and trees makes life better for those that remain, improving chances for survival and growth, while making wood products, recreational opportunity, and a meal or two available for human consumption.

The second major natural resource program — fish and wildlife management — applies to all Naval lands. Whereas forest management generally requires a minimum of 20 acres of forestland, wildlife conservation programs can and should be developed for all Navy lands. Although the larger installations may first think of hunting when the subject of wildlife comes up, non-game species are just as important.

Wildlife needs should be considered and incorporated in formal landscape plans, in rehabilitation of drastically disturbed areas such as building demolition sites, as well as in more remote forested or brush areas where game management may be of prime concern.

Non-game wildlife are often forgotten on small installations in urban/suburban locations although small investments here are likely to pay very attractive dividends. Often the small semi-natural improved grounds surrounding Naval installations have great potential as wildlife habitat preserves for a wide variety of songbirds and small mammals. Quite a few ornamental tree and shrub species produce wildlife food in the form of berries and other fruit.

However some plants, while of great benefit to wildlife in less developed locations, are not well suited for landscape purposes. Natural resource managers can supply reference texts and pamphlets to help in the selection of appropriate plant materials that will serve all intended purposes well.

This program aims to conserve the basic land and water resources.

Whether or not the forest or wildlife are actively managed, the soil and water resources must be. Not only are the pollution and sediment control laws behind the essential nature of this program but the public's real property investment must be safeguarded. Wise stewardship is required by law. Of more parochial concern is the need to protect the land and water resources to maintain their usefulness for their intended military purposes.

Recent Federal and State laws, Executive Orders, and command instructions deal with the responsibilities of the Department of Defense and the Navy in the natural resource area, such as the Endangered Species Act, Wetlands Protection Act, Sikes Act, etc. Many Naval shore activities have or are interested in expanding their natural resource-related endeavors, but often an abrupt dividing line seems to exist between the natural resource program and military mission priorities.

There's usually no question that the military mission is top priority unless critical habitat of an endangered species is involved. However that is not reason to ignore or term infeasible natural resource management on smaller installations or to limit natural resource management to areas far away from important, highly visible, secure, or even hazardous areas. Further, a command should not limit the scope of a natural resource program because some short-term, relatively minor inconveniences that may be created. An example would be the disturbance created by timber harvesting.

All natural resource management programs can be custom-tailored to meet the needs of the area regardless of size or location when natural resource professionals and station's Public Works Office work closely together.

The ultimate goal of all natural resource management programs should be and usually is to maintain the natural environment and resources in perpetuity via conservation or the wise use of the resources. Conservation management is a plus for both the natural environment and the military mission, in effect preserving the value of the land for its military use as well as maintaining or enhancing the natural resource values for the public's benefit.

As an example, at the Naval Surface Weapons Center, White Oak (approximately 400 acres which is located just outside the District of Columbia line in a decidedly upper-income bracket surburban setting), two small timber sales have been successfully administered within the last five years without disrupting station activities or compromising the scenic or other values of the wooded areas to the station and surrounding community. The government has received $20,000 for the timber, which went into a reimbursable account and was used to pay for other forestry practices recommended in forest management plans. More sales are planned on a continuing basis.

Natural resource programs must be continuous, rather than infrequent, unrelated, poorly-coordinated actions. Personnel are presently inventorying and will prepare a new management plan for White Oak's forest and wildlife by the end of the current fiscal year. Wildlife food and cover plantings and bird-nesting boxes are also planned to encourage songbirds and other non-game wildlife at NSWC White Oak.

An example of areas where natural resource management is sometimes excluded but should almost always be included are the buffer zones between and around explosive testing facilities and ammunition storage magazines. Generally a protective veil of large trees is desired around such facilities. Yet oftentimes if nothing is done to help young trees become established, the older trees can blow over due to declining vigor, old age, and a helping hand from a hurricane or wind and ice storm. Then all that is left are some small trees, shrubs, and vines for five to ten years instead of good-sized trees. With intelligent forestry practices a healthy, perpetual tree canopy may be maintained relatively free from the threat of blowdown.

Often when the military mission priorities require construction and maintenance of roads, pipelines, or new buildings, coordination with natural resource personnel is after the fact. Minimizing the unnecessary destruction caused by construction activities is relatively simple and not inordinately costly. Communication links must exist between natural resource personnel (either at the station or Engineering Field Division (EFD) level or *both*) via the Public Works Officer to the bulldozer, grader, or backhoe operator.

It helps a great deal to have on-site inspection and review of plans and specifications of projects by natural resource personnel before the final drafts are prepared or the maintenance work begins in any natural area. Such coordination prevents more trees than necessary from being bulldozed or permanently damaged and keeps soil from eroding into surface waters. In a few instances coordination can eliminate the risk of violating a Federal law, Executive Order, or instruction, and possibly a suit by a concerned environmentally-attuned private citizen, group, or foundation. All this without adding much if anything to the project's price tag.

All EFD's have natural resource management staffs that are available for informal consultation and review of any natural resource-related issue at your activity. They may not always have the answers but the advice is free to the stations and they can arrange for further consultation with various Federal and State natural resource agencies if more expertise is required.

Limited funding may be available (in accordance with NAVFAC instructions and subject to NAVFAC's final approval) to a station to defray some costs related to implementing a natural resource program. Explanations and justifications for the appropriate use of natural resource funding is adequately addressed in Department of Defense, NAVFAC, and EFD instructions.

There are natural resource management responsibilities as well as opportunities, regardless of station size or location. The responsibilities are not to difficult to live with and getting involved can be very rewarding. Natural resource personnel on the stations and at the EFD's are available for consultation concerning natural resource problems and program guidance.

Natural resource management is an attempt to control natural events for the benefit of people. □

ABSTRACTS OF THESES

By LCDR NEIL BROMILOW
CEC, USN
P.E., Va.
CECOS

Oil and electricity are two topics that have a deeper meaning today because of their scarcity. Under the sponsorship of the Naval Facilities Engineering Command, graduate work has been undertaken in these fields. The papers abstracted below discuss two aspects of the energy problem: oil transportation and electricity conservation.

The Moreell Library at the Naval School, Civil Engineer Corps Officers, catalogs these papers for loan. All theses or major papers are solicited for use by the entire Civil Engineer Corps.

A PROPOSED METHODOLOGY FOR ANALYZING THE NAVAL PETROLEUM RESERVE NUMBER ONE, ELK HILLS, PIPELINE CONSTRUCTION DECISION

Key Words: Pipeline Construction; Oil Transportation; Elk Hills.

Abstract: Public Law 94-258 requires that a transportation system capable of moving 350,000 barrels of crude oil per day from Naval Petroleum Reserve Number One, Elk Hills, California, to market be provided by the Navy. Analysis of this law results in the identification of a problem statement to determine the transportation system which provides maximum net revenue considering the differential costs and revenues of the possible alternative pipeline routes.

A methodology is proposed under which alternatives can be considered in a common format and aggregated so as to make a rational choice. Costs are based on engineering studies previously conducted. Revenue from the sale of the crude oil is based on the production volume multiplied by the well price of the crude. This well price is determined by establishing refinery market locations, flow, and prices and subtracting transportation costs back to the well. Revenue from operation of the Navy owned portion of the transportation system is based on the projected pipeline tariff and flow rate.

Reference: *Rabold, B.L., LT, CEC, USN,* "A Proposed Method for Analyzing The Naval Petroleum Reserve Number One, Elk Hills, Pipeline Construction Decision," Naval Postgraduate School, June 1977.

ELECTRICAL ENERGY ALLOCATIONS AT NAVY AND MARINE CORPS BASES

Key Words: Electrical Allocation; Load Shedding; Utility Analysis.

Abstract: Navy and Marine Corps bases in the continental United States derive almost all of their electricity from public utility companies. For this thesis, the conditions of service of select public utility companies in one part of the United States, namely the West Coast, were investigated. Particular attention was devoted to the utility companies' plans to allocate electricity to their customers if an emergency or a fuel shortage should occur.

The second major area investigated was the internal management of electricity within the Navy and Marine Corps bases. The load shedding plans of about 80 bases were reviewed, and from these, guidelines were developed for the preparation of an optimal load shedding plan. Also, a unique approach to electrical allocation was developed. The approach is based on the utility theory of economics.

Finally, investigation was conducted into the potentials of central process controllers, which are solid state electronic devices designed to provide improved controls over energy consuming systems.

Reference: *Shalar, A., LCDR, CEC, USN* "Electrical Energy Allocations at Navy and Marine Corps Bases," Naval Postgraduate School, March 1975. □

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